Sustainable Smart Cities

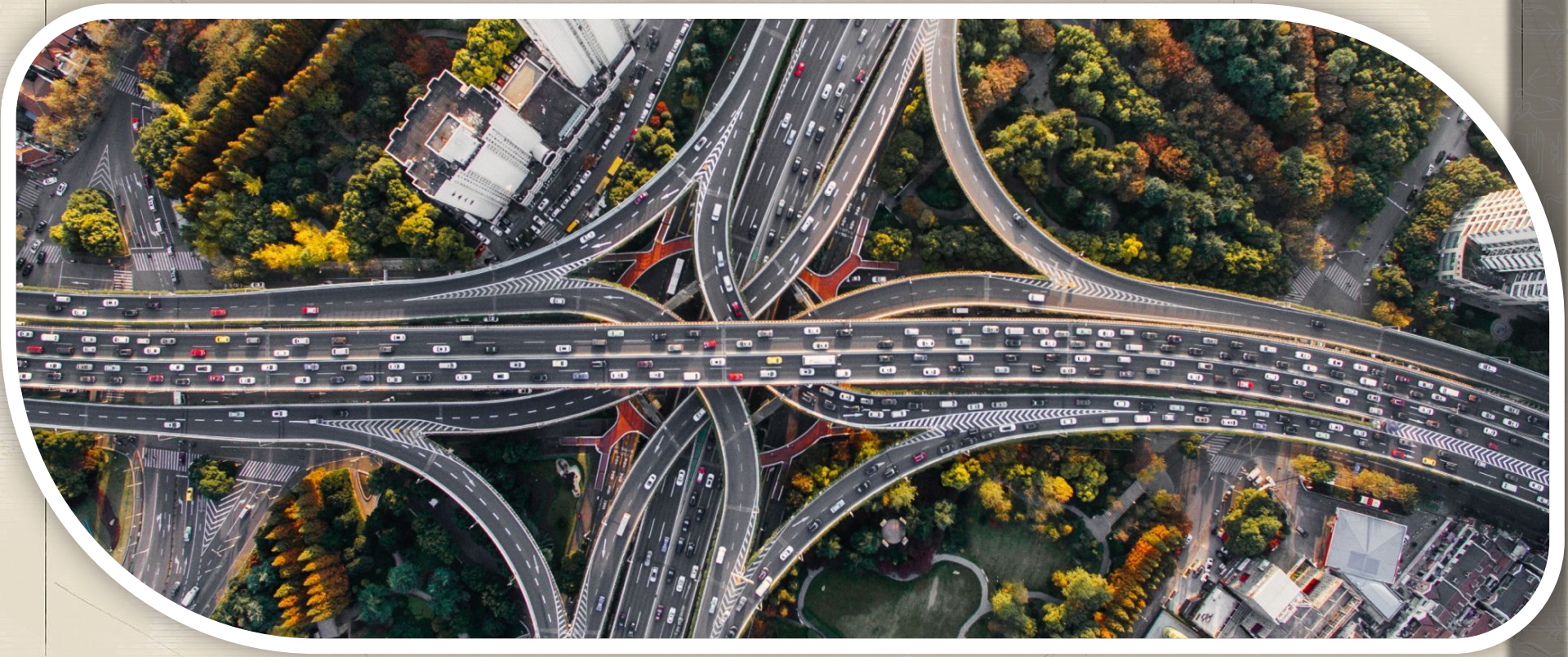
Omar Selim

Sustainable Development Goals

1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

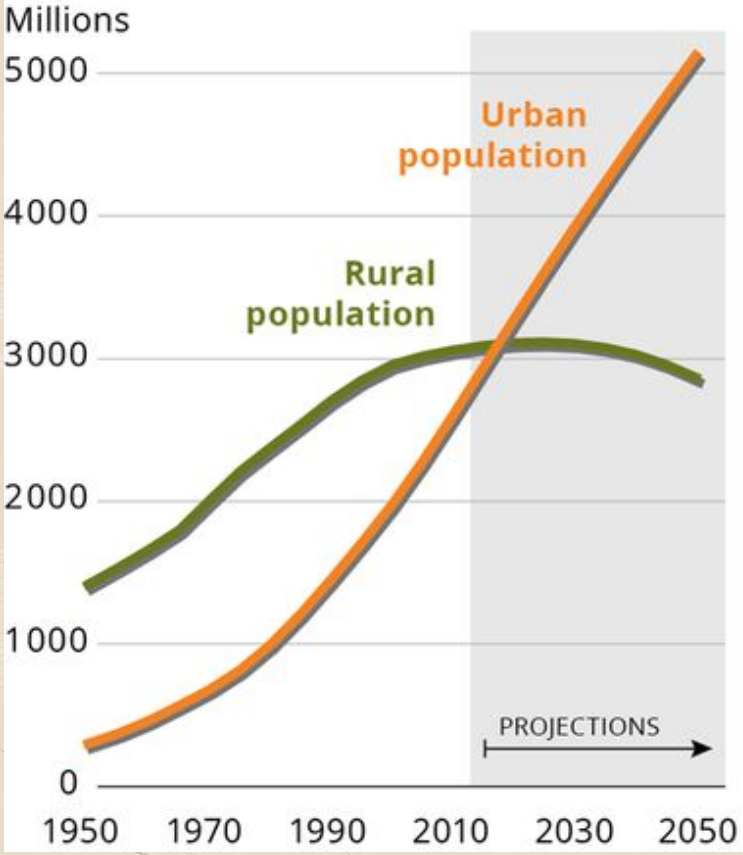
ALKWKB.COM

68% of the world population projected to live in urban areas by 2050, says UN.



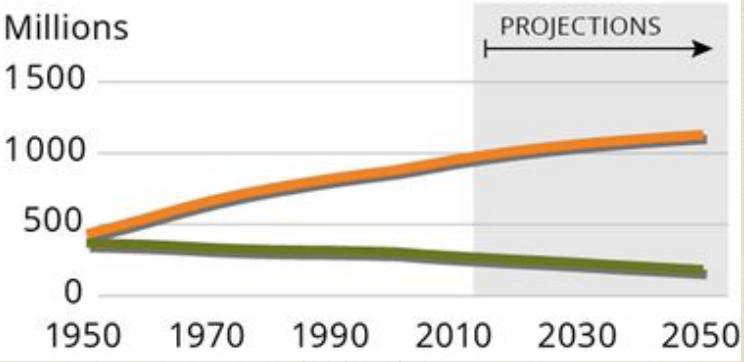
Less developed regions

Africa, Asia (excluding Japan), Latin America and the Caribbean, Melanesia, Micronesia and Polynesia.



More developed regions

Europe, Northern America, Australia, New Zealand and Japan.



Why cities need to become smart now

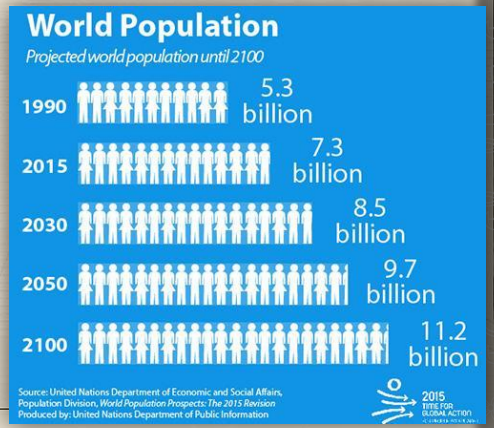
In 1960, the **global population** around **3** billion
The World Bank puts the 2016 population at **7.44** billion – a rise of almost **146%** in just **56** years

According to the Swiss-based international standards agency, International Electrotechnical Commission (IEC),

*"every day, urban areas grow by almost **150,000** people, either due to **migration** or **births**".*

A dramatic **rise in demand** on resources, from food and water through to energy, space, and clean air.

cities that were designed for **yesterday's populations**, **using yesterday's technologies** are **beginning to buckle** under the strain of **meeting the needs** of today's never-envisaged populations.



Why cities need to become smart now

33 megacities with more than ten million inhabitants)

The challenge will be to supply these populations with basic resources like
safe food, clean water and sufficient energy,
while also ensuring overall **economic**, social and environmental sustainability.

According to the World Health Organization's Global Health Observatory (WHOGHO),
ambient air pollution contributes to **5.4% of all deaths**.
Currently, **92%** of the world's population
lives in places where air quality
exceeds WHO guideline limits.

promises modern cities must fulfil if they are to
stay competitive and provide a decent
quality of life to their citizens:-

Sufficient fresh water;
universal access to cleaner energy;
the ability to travel efficiently from one point to another;
a sense of safety and security:

What are smart cities?

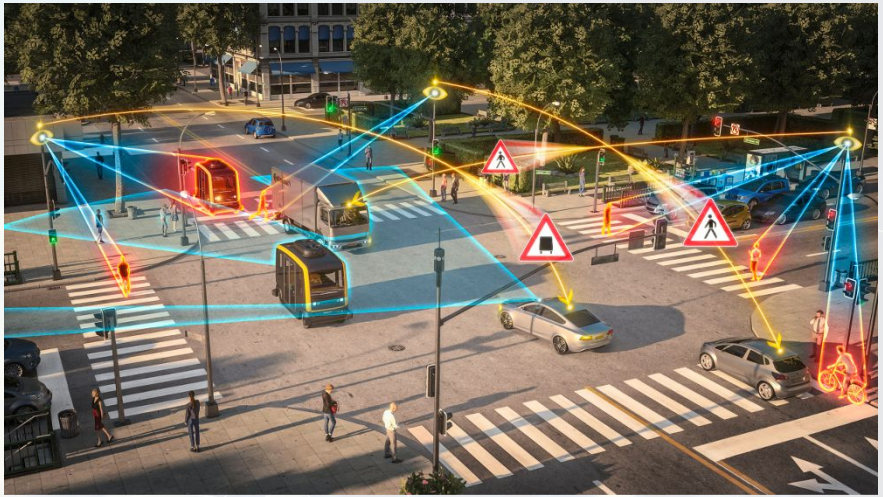
Smart cities are new cities specifically designed and built to capitalize on the **full potential of technology**

to both address **difficult issues** traditionally associated with: large urban development, including sustainability, congestion, transport and energy use,

while at the same time **improving the quality of life** for inhabitants through benefits such as :

quicker access to **healthcare**, more integrated **transport** and less **pollution**

- **Better Planning & Economic Growth**
- **Less Pollution and Reduced Energy Consumption**
- **Better and Faster Infrastructure**
- **Less Commuting & Better Transportation Systems**
- **Reduced Traffic Accidents**
- **Better Crime Control**
- **Responsive Government Action**
- **Cost-Efficiencies & Competitiveness**



The Smart Cities Council, a network of leading companies advised by top universities, laboratories and standards bodies, says: *"The smart city sector is still in the 'I know it when I see it' phase, **without a universally agreed definition**."*

*as one that has **digital technology embedded across all city functions**.*

*a "process, or series of steps, by which cities become more 'livable' and resilient and, hence, able to **respond quicker** to new challenges."*

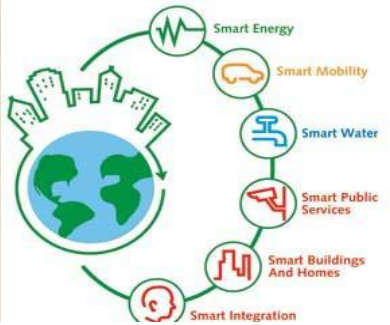
according to a UK government smart cities report

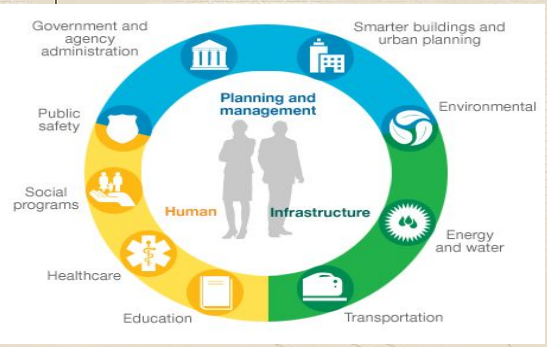
Source : Do we really need smart cities? TechRadar, 20 March 2016

Definitions and overviews, Smart Cities Council, accessed April 2018

Smart Cities Definition.

. In year 2007, Prof Rudolf Giffinger of Vienna University of Technology formally coined the term “Smart City” Smart City uses technology and ICT to better quality & performance to engage more effectively and actively with its citizens. The Smart City includes government services, transport, traffic management, energy, health care, water and waste.



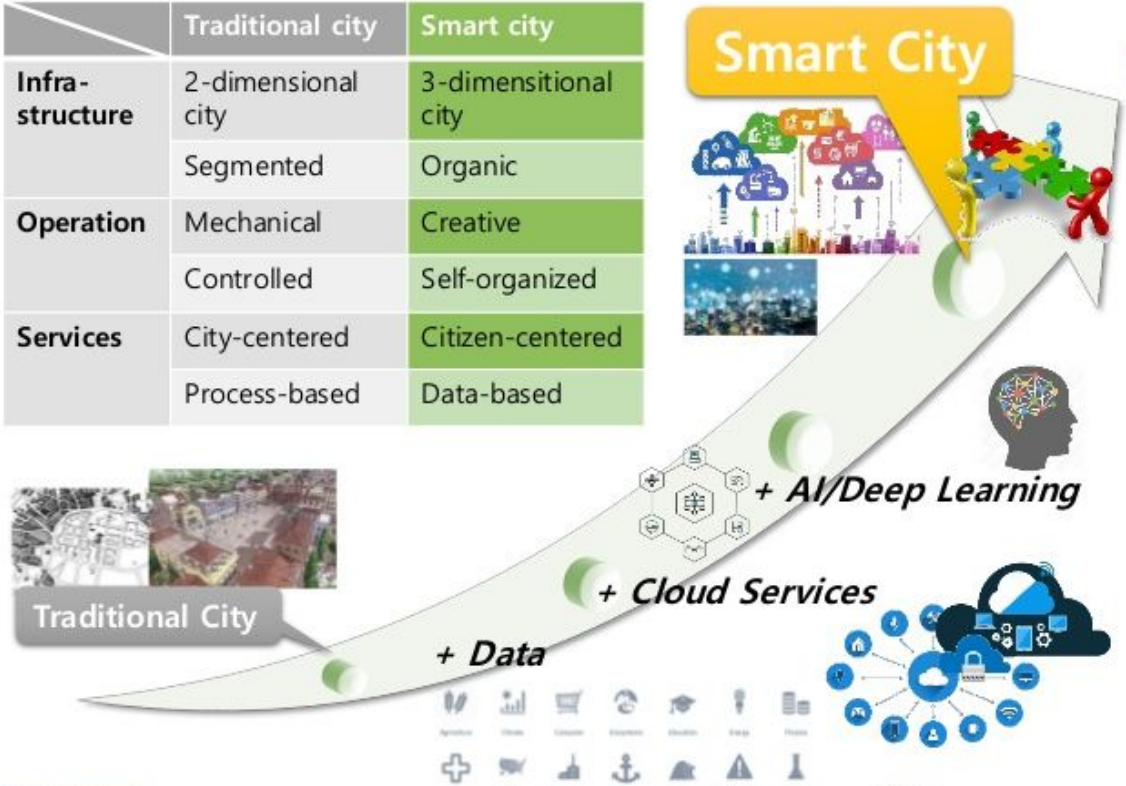


The Definitions of Smart Cities

Division	Definition
Ministry of Land, Infrastructure and Transport	Future city that utilizes cutting-edge ICT for all urban resources such as human resources, environment, energy, transportation, and urban infrastructure to realize continuous economic development and quality of life
ITU	Smart Sustainable City is **an innovative city that uses ICT to improve the quality of life, the effectiveness of city operations and services**, and competitiveness. This ensures the needs of present and future generations in economic, social, environmental and cultural aspects.
IBM	A city that can collect, analyze, and integrate information using ICT, which is the key to the core system to operate the city.
Hall(2000)	A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens
Smart Cities Council	City using IT and ICT to improve livability, workability and sustainability

SMART CITY SERVICES

	Traditional city	Smart city
Infra-structure	2-dimensional city	3-dimensitional city
	Segmented	Organic
Operation	Mechanical	Creative
	Controlled	Self-organized
Services	City-centered	Citizen-centered
	Process-based	Data-based



Smart City Services

	Services
Transport /Logistics	• Intelligent Safety Management System for subway/rail/bus • Smart Crosswalk • Autonomous Car / Smart Parking • Traffic Information Collection and Bypass Road Guidance • Traffic/Cargo Traceability
Environment	• Air Quality Management System • Subway Vent Management System • Smart City-Environment Management System
Energy	• Smart Building Energy Save System • Electric Car Charging Station • Smart Store Energy Management
Safety	• Smartcity Disaster Prevention System • Safe Driving Alert System • Smart anti-kids-lost services • Smart Traffic Safety Services in School Zones • Socially Underprivileged Security Services
Healthcare	• Medicines and Medical Devices Management System
Food Services	• Food Safety Systems • Disclosure / Tracking / Recall Service

Smart Sustainable City

IoT Technologies

- Legality and Security
- Air Quality
- Digital Transformation
- Green Urban Areas
- Water Quality

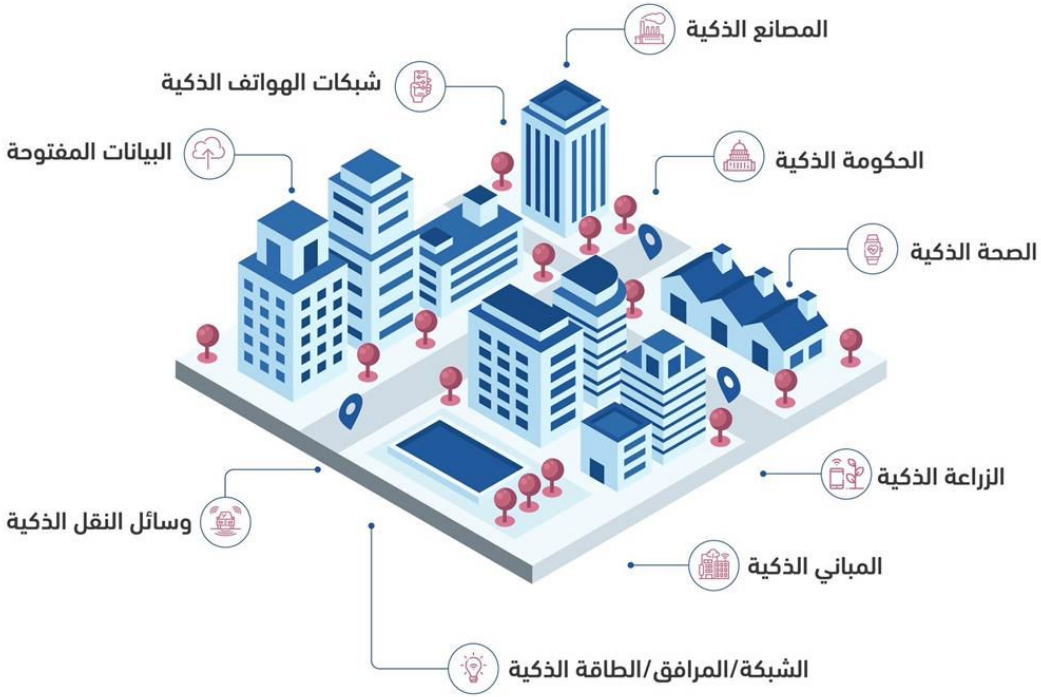
- Energy
- Occupation
- Waste Management
- Sustainable Mobility
- Tourism and Culture

Sustainability Indicators

''Doha smart city''

تقنيات
المستقبل

مكونات المدينة الذكية

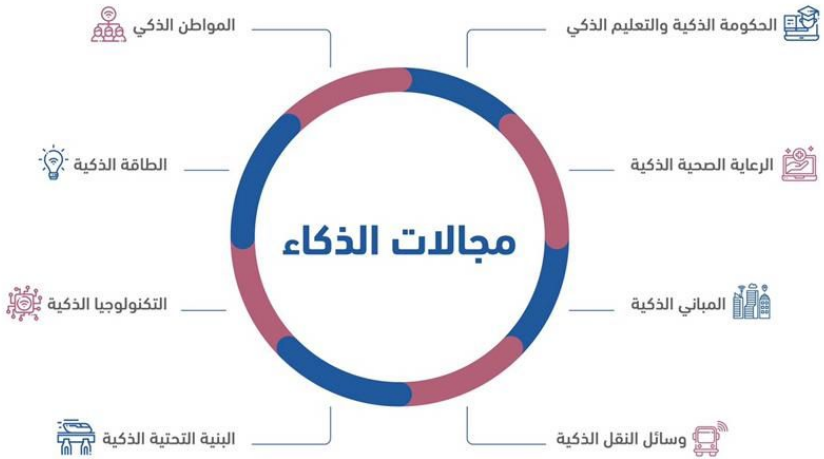


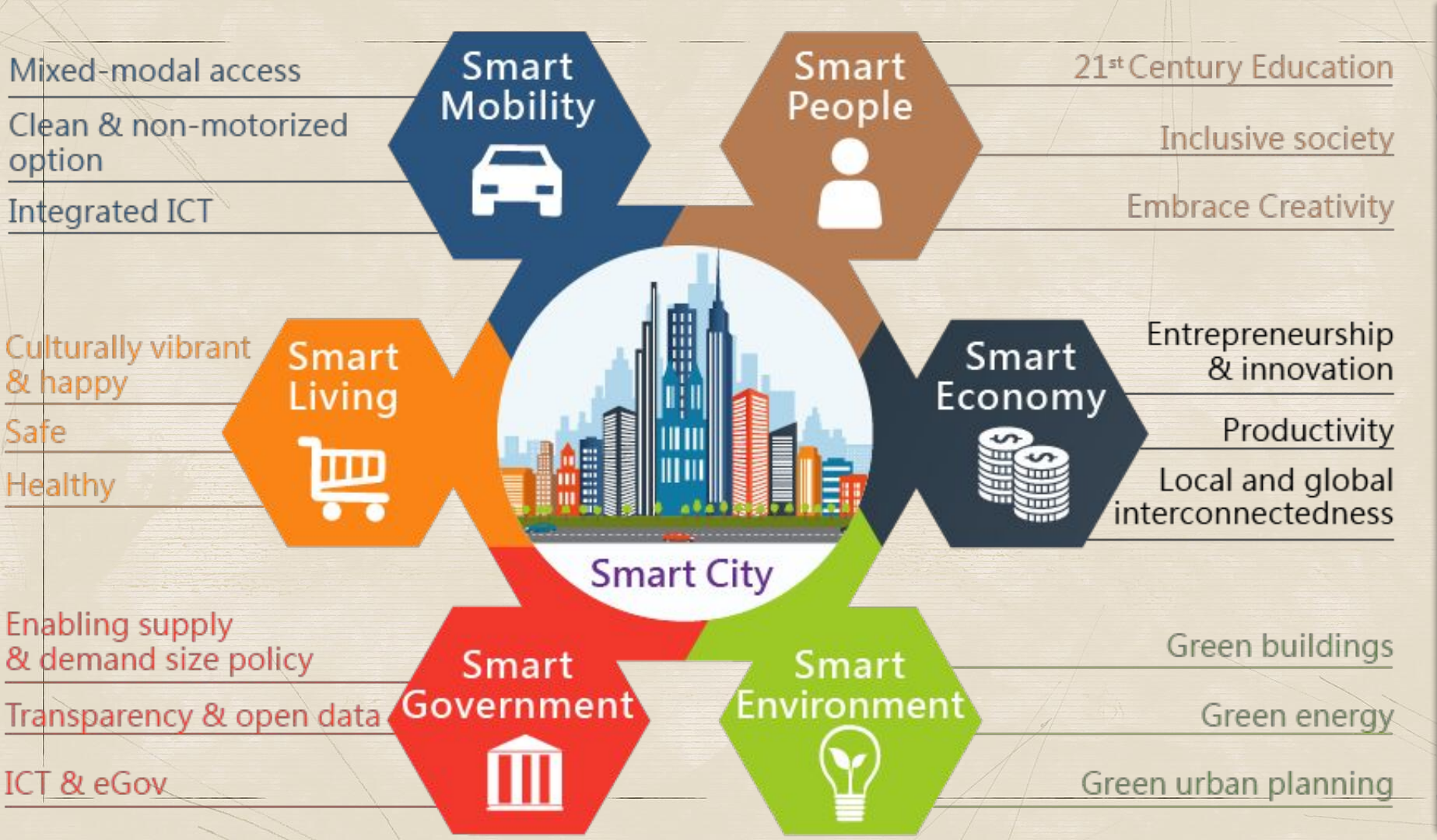
تقنيات
المستقبل

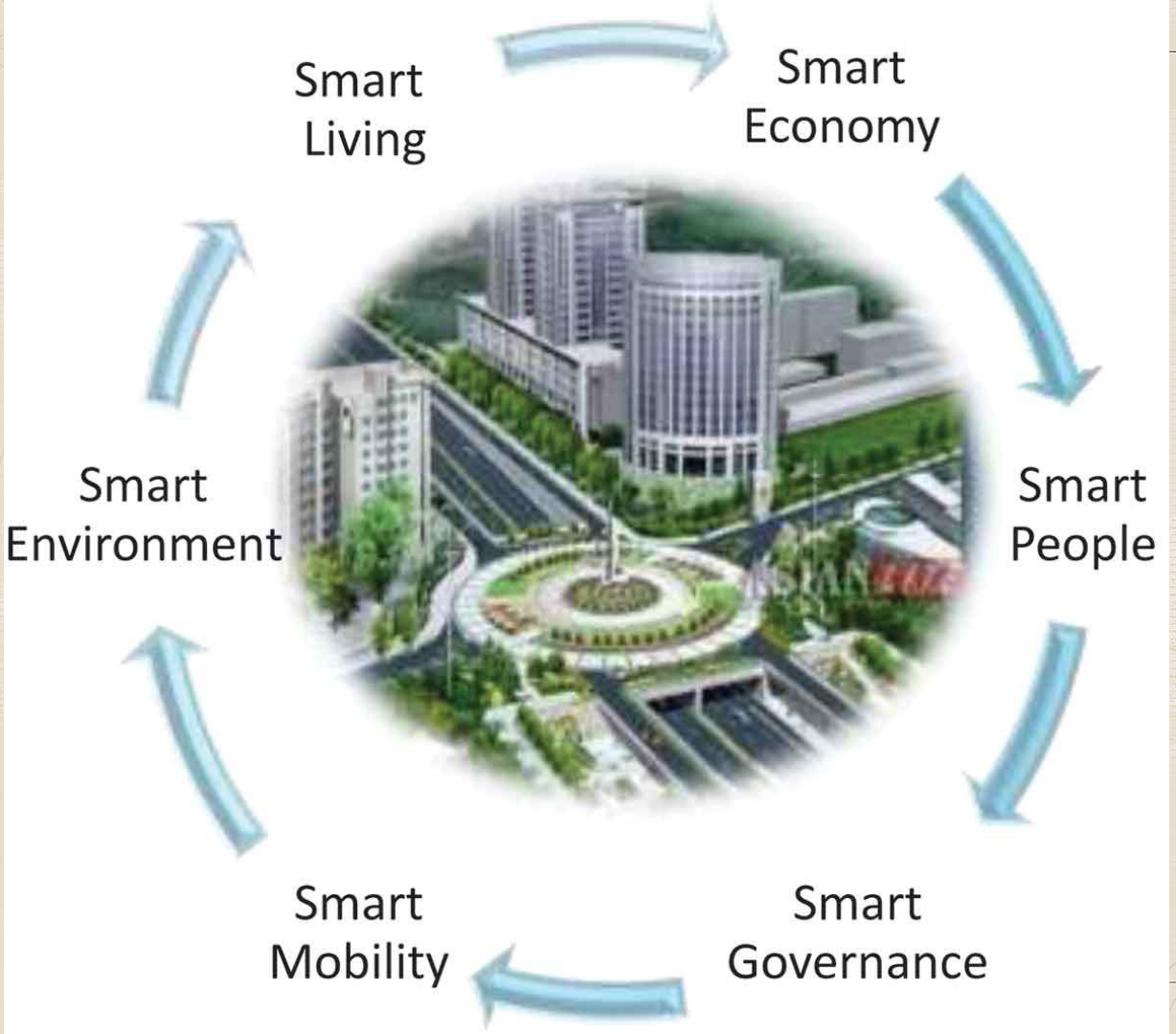
مستقبل المدن الذكية

وفقاً ل Forst & Sullivan فإن اكثر من 40% مدينة عالمياً ستصبح مدن ذكية في عام 2020
وأكثر من 50% من المدن الذكية لعام 2025 ستكون من أوروبا وأمريكا الشمالية والصين والهند

%50 2025



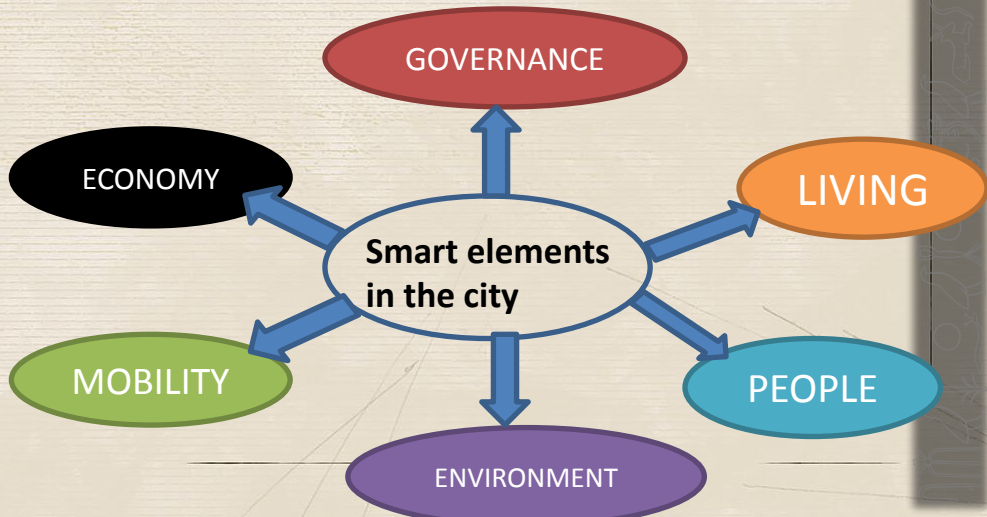

Mixed-modal access
Clean & non-motorized option
Integrated ICT
Smart Mobility
Smart People
21st Century Education
Inclusive society
Embrace Creativity
Culturally vibrant & happy
Safe
Healthy
Smart Living
Smart Economy
Entrepreneurship & innovation
Productivity
Local and global interconnectedness
Smart City
Enabling supply & demand size policy
Transparency & open data
ICT & eGov
Smart Government
Smart Environment
Green buildings
Green energy
Green urban planning


Smart Living
Smart Economy
Smart Environment
Smart People
Smart Mobility
Smart Governance

SEVEN SMART CITY PILLARS

Bhubaneswar has identified seven smart city pillars which align the citizen's aspirations and needs with city systems.

1. City planning and design
2. Urban utilities (water, smart waste management, sanitation and waste water management, energy, and ICT / IT connectivity)
3. Shelter, with a focus on inclusive housing
4. Economic development, economy and employment
5. Social development, including identity and culture, education, health, open spaces, safety and security, and air quality



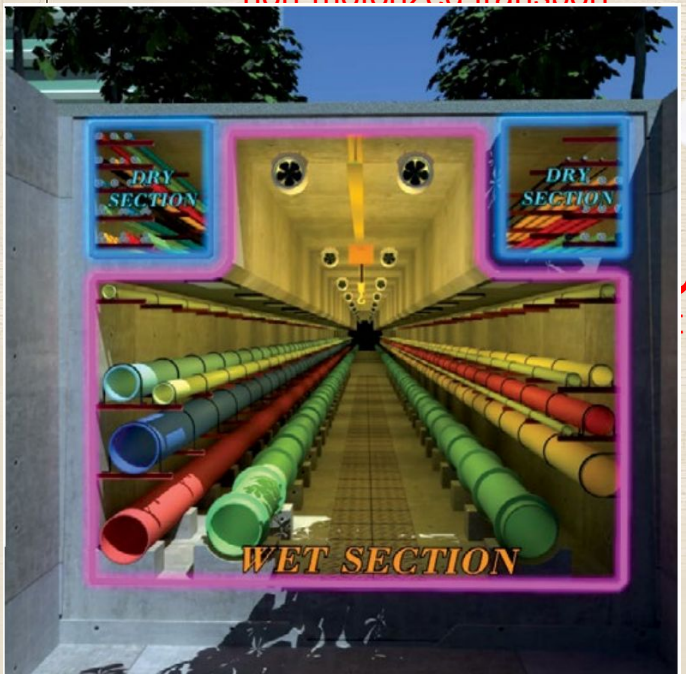
Mobility

Urban mobility, including street design

and public transport

Vehicles

- intermodality
- vehicle sharing / pooling
- low environmental impact
- non-motorized transport

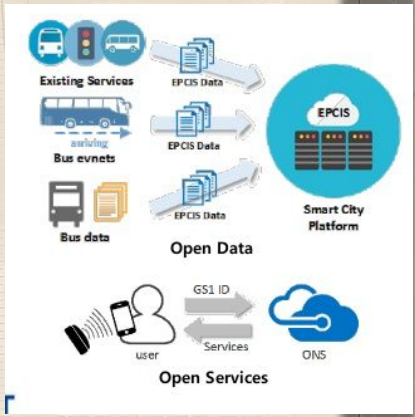


ure

traffic lights

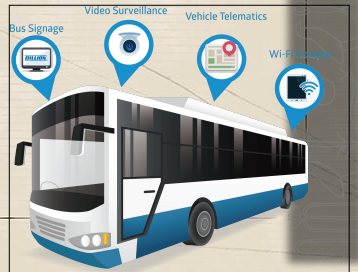
People

- sharing information
- emergency management
- security



Service

- fleet management
- freight logistics
- electronic payment systems



Inclusion

Education / Training

- evolution of educational paradigms
- learning tools for disabled
- inclusion for foreign students
- training for immigrants
- professional training for unemployed

Social Communication

- neighborhood level and social support
- volunteering support
- Integration / involvement of unemployed
- contrast to the immigrants isolation

Outdoor TOMI accessible information kiosk
(Courtesy TOMI World)

Life & Health

Environment and Territory

- waste / water management
- environmental quality analysis
- Territory monitoring
- territorial planning
- disaster prevention
- Infrastructure monitoring

Security

- night urban surveillance/prevention and fighting crime
- monitoring and managing of Big events
- public order management
- security for moving users

Gunshot Detection Technology

Culture and Tourism

- promotion of cultural heritage
- conservation and upgrading of assets
- promotion of tourism

Accessibilità

- to the structures / usability
- to the cultural resources of the city

Energy

Buildings
- Consumption monitoring
- Plant automation / energy saving systems
- Interfacing with energy networks
- Interfacing with Renewable Energy Sources

People
- interactions between man and building
- saving energy awareness policies
- community management (e.g. at condominium level)

Infrastructures
- smart grid
- smart heating/cooling networks
- Support for vehicular networks (electric recharge)

Vehicles
- low impact vehicle
- driving style (eco-driving)
- travel planning (eco-routing)

Energy

1. **Buildings**
   - •Consumption monitoring
   - •Plant automation / energy saving systems
   - •Interfacing with energy networks
   - •Interfacing with Renewable Energy Sources
2. **People**
   - •interactions between man and building
   - •saving energy awareness policies
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3. **Infrastructures**
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   - •Support for vehicular networks (electric recharge)
4. **Vehicles**
   - •low impact vehicle
   - •driving style (eco-driving)
   - •travel planning (eco-routing)

How to implement and support the strategy

- **SMILE** cannot be separated by considerations of **economic sustainability,** in order to:
  - better address the resources and avoid investments incorrect or counterproductive
  - Reduce the risk of sanctions
  - Better focus the main objectives, taking into account options for long-term sustainability

- ☐ **Public-private partnership, pre-commercial procurement of innovation**
- ☐ **National R&D Projects and EU (Horizon 2020)**
- ☐ **Rules and regulations to support the dissemination of developed solution**

Why sustainability?

We need to build sustainably to:

1. Preserve our environment
2. Reduce the buildings' costs
3. Increase efficiency & durability
4. Provide healthy environments for people

HOMES AND BUILDINGS IN INDUSTRIALIZED COUNTRIES REPRESENT*
40% OF ENERGY CONSUMPTION
12% OF DRINKING WATER CONSUMPTION
38% OF GREENHOUSE GAS EMISSIONS
40% OF SOLID WASTE

"Building Design and Construction: Forging Resource Efficiency and Sustainable Development", United Nations Environment Program-Sustainable Buildings and Climate Initiatives (UNEP-SBCI)

How can a Cities be sustainable?

Sustainable Cities are designed and constructed to perform effectively while:

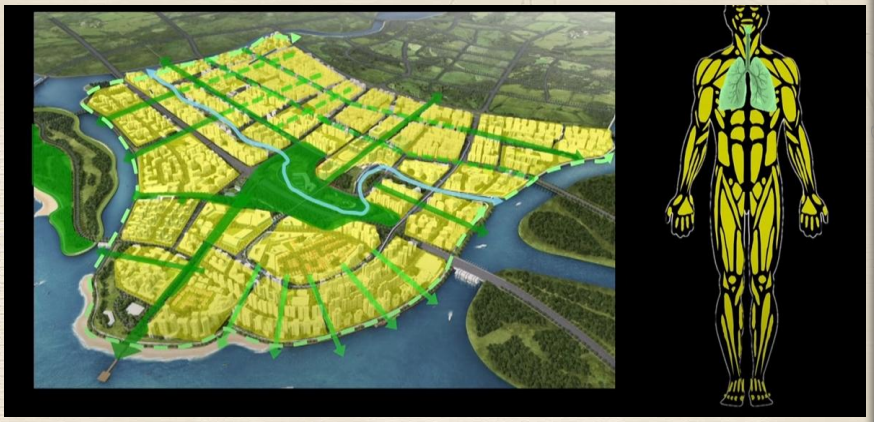
1) Minimizing energy requirements
2) Reducing water consumption
3) Reducing carbon footprint
4) Using materials that have low environmental impact
5) Reducing wastage
6) Conserving the natural environment
7) Safeguarding human health and wellbeing

Sustainability of a building is influenced by:

– Building performance
– Environmental, economical & social impacts

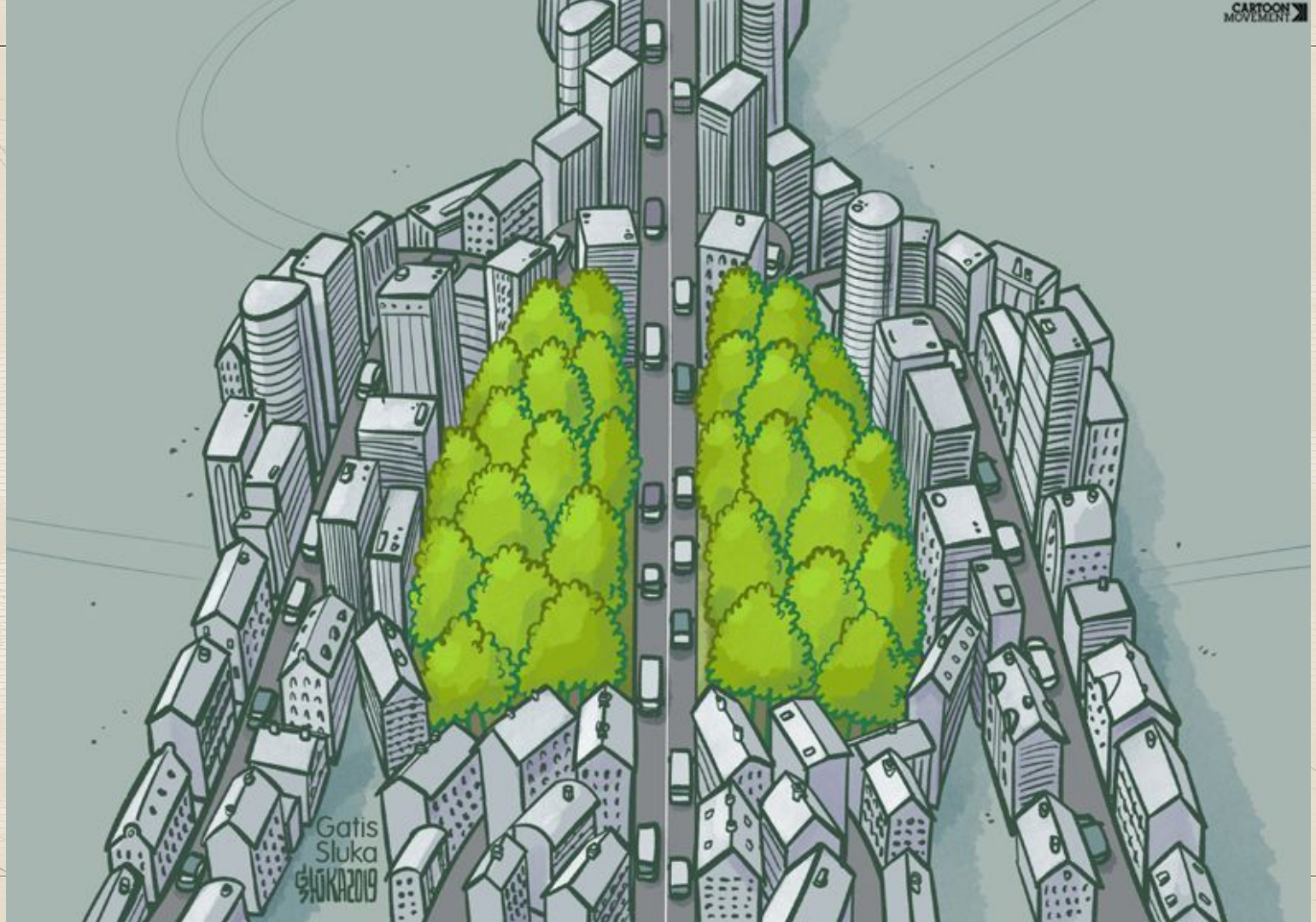
BIM advantages include:

– Ability to analyze
– Ability to evaluate green buildings
– Access to information to make sustainable decisions



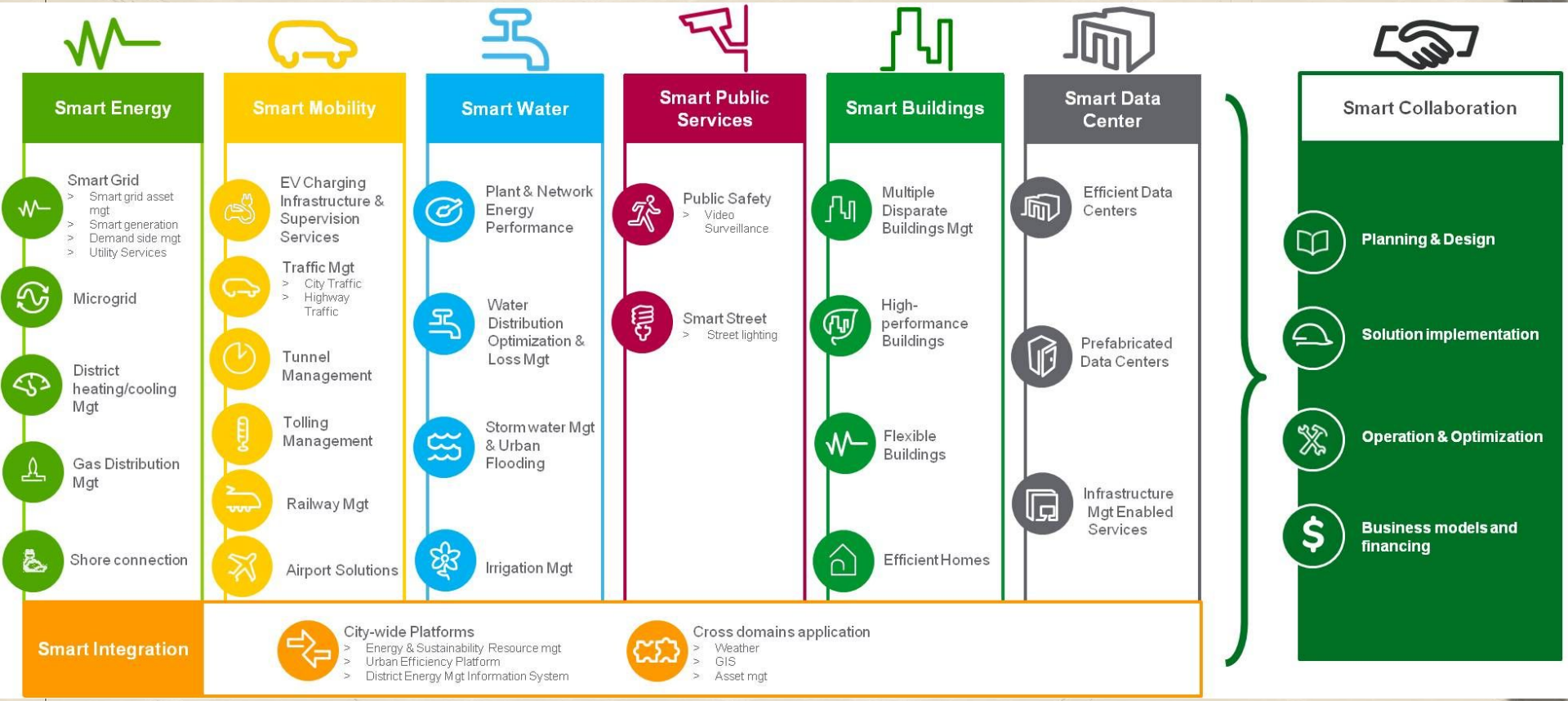
https://apps.london.gov.uk/greener-city/#14.88/51.45081/-0.01014/0/45 london

Source - How we design and build a smart city and nation | Cheong Koon Hean | TEDxSingapore


CARTOON MOVEMENT
Gatis Sluka
SLUKA2019

How will we better plan, design, construct and operate our cities and infrastructure in a more sustainable way for the future?

We must Change our Ways


Smart Energy
Smart Grid
> Smart grid asset mgt
> Smart generation
> Demand side mgt
> Utility Services
Microgrid
District heating/cooling Mgt
Gas Distribution Mgt
Shore connection
Smart Mobility
EV Charging Infrastructure & Supervision Services
Traffic Mgt
> City Traffic
> Highway Traffic
Tunnel Management
Tolling Management
Railway Mgt
Airport Solutions
Smart Water
Plant & Network Energy Performance
Water Distribution Optimization & Loss Mgt
Storm water Mgt & Urban Flooding
Irrigation Mgt
Smart Public Services
Public Safety
> Video Surveillance
Smart Street
> Street lighting
Smart Buildings
Multiple Disparate Buildings Mgt
High-performance Buildings
Flexible Buildings
Efficient Homes
Smart Data Center
Efficient Data Centers
Prefabricated Data Centers
Infrastructure Mgt Enabled Services
Smart Collaboration
Planning & Design
Solution implementation
Operation & Optimization
Business models and financing
Smart Integration
City-wide Platforms
> Energy & Sustainability Resource mgt
> Urban Efficiency Platform
> District Energy Mgt Information System
Cross domains application
> Weather
> GIS
> Asset mgt

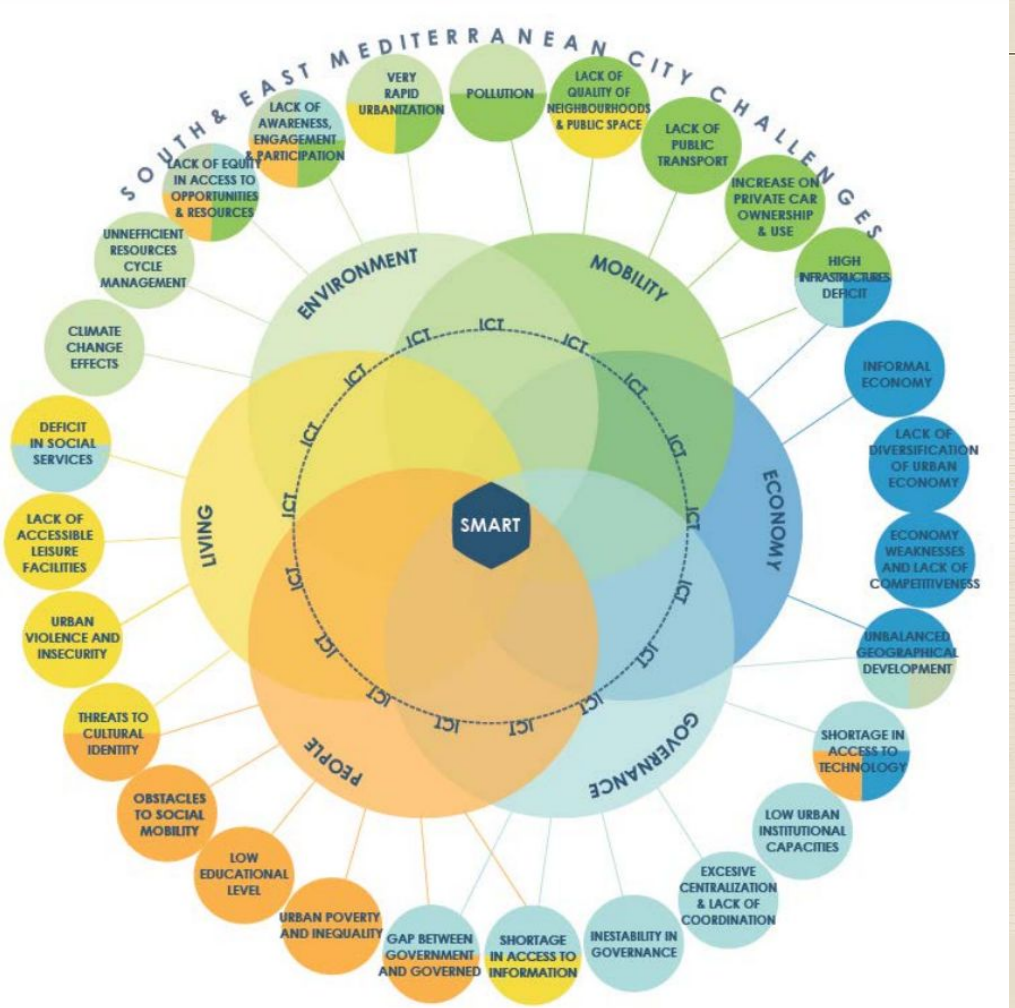


Figure 2. South & East Mediterranean City challenges correlated with Smart City dimensions

SMART
CITY
Ubermetrics

… fueled by a combination of disruptive technologies and social innovations …

Most new technologies and social innovations are disruptive on their own. The combination of them is even more powerful and creates a 'perfect storm' of disruption.

Smart City Capability Framework

Successfully building a smart city requires a clear strategy and maturity in seven capability dimensions.

Goals

- Economic growth
- Quality of life, a good city to live in
- Ecological footprint, sustainability

Challenges

- Social cohesion, inclusiveness
- Secure digital environment, privacy
- Resilience

- Smart Mobility
- Smart Safety
- Smart Energy, Water & Waste
- Smart Buildings & Living
- Smart Health
- Smart Education
- Smart Finance
- Smart Tourism & Leisure
- Smart Retail & Logistics
- Smart Manufacturing
- Smart Government

SMART CITY USE CASES

- SMART PARKING
- WEATHER SENSORS
- DIGITAL SIGNAGE
- ACOUSTIC SENSORS
- WATER & GAS METERING
- TRAFFIC LIGHTS & CONTROLS
- ELECTRIC VEHICLE CHARGING
- SOLAR INVERTERS
- SECURITY AND SURVEILLANCE
- WASTE MANAGEMENT

ILLUSTRATIVE LIST

Smart Solutions

E-Governance and Citizen Services

1. Public Information, Grievance Redressal
2. Electronic Service Delivery
3. Citizen Engagement
4. Citizens - City's Eyes and Ears
5. Video Crime Monitoring

Waste Management

6. Waste to Energy & fuel
7. Waste to Compost
8. Waste Water to be Treated
9. Recycling and Reduction of C&D Waste

Water Management

10. Smart Meters & Management
11. Leakage Identification, Preventive Maint.
12. Water Quality Monitoring

Energy Management

13. Smart Meters & Management
14. Renewable Sources of Energy
15. Energy Efficient & Green Buildings

Urban Mobility

16. Smart Parking
17. Intelligent Traffic Management
18. Integrated Multi-Modal Transport

Others

19. Tele-Medicine & Tele Education
20. Incubation/Trade Facilitation Centers
21. Skill Development Centers

Changing our Ways

Old Way	New Way
Analog	Digital
Silos	Collaborative
Reactive	Proactive
Error Prone	Predictable
Disconnected	Interoperable
2D Paper Drawings	Intelligent 3D Models

We must build and share Smarter Models in a smarter way

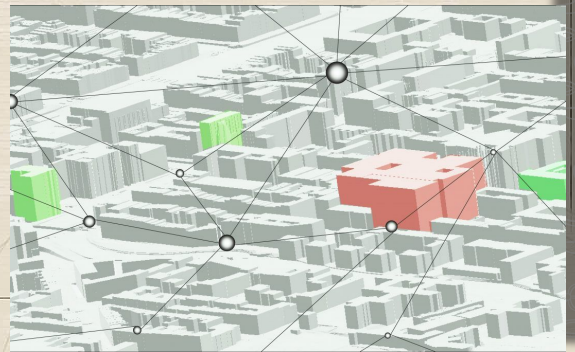
GeoBIM = integration of geoinformation with BIMs

1. Integration of data (common characteristics, they fit together)
2. Data interoperability
3. Reliable conversions BIM « GIS
4. Integration of procedures (BIM and GIS (Geographic Information System) tools)

3D geoinformation:

3D city models

\+ Building Information Models



GEO WORLD POINT OF VIEW

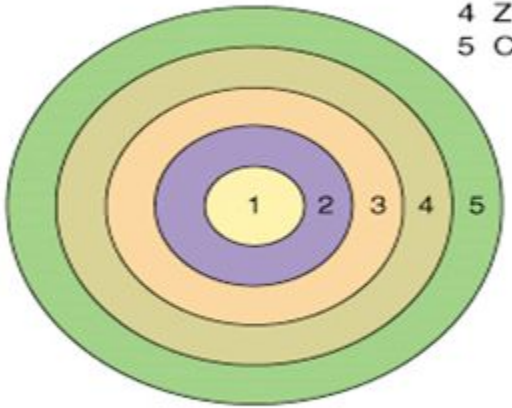
- High level of detail 3D cadaster
- No tasks duplication (3D data collection)
- Efficient databases updates without additional costs
- Effective data exchange with professionals (architects, engineers, environmental scientists, etc.)
- Stronger information for lifecycle asset management & city analysis

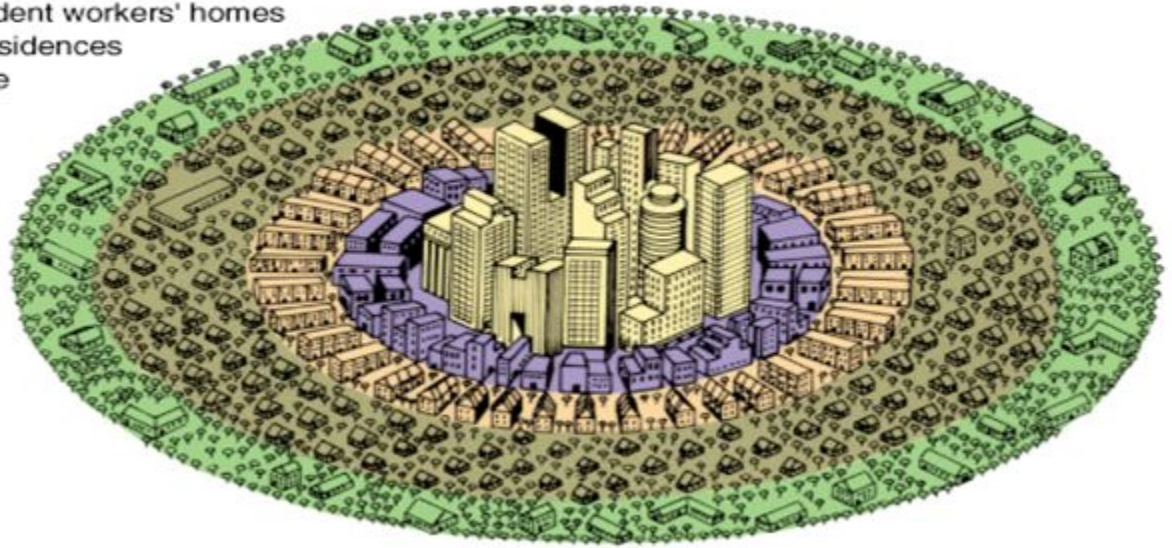
BIM world point of view

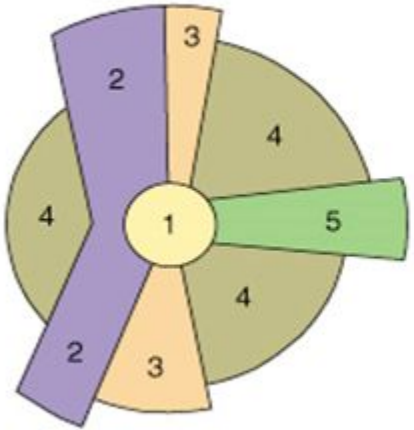
- Context for design reference
- Improved test of building properties: designed building into its context
- Test of the impact of the building on the city or
- landscape.
- Multiscale vision (from construction elements to whole territories)
-

Modeling Cities: Concentric Zone Model

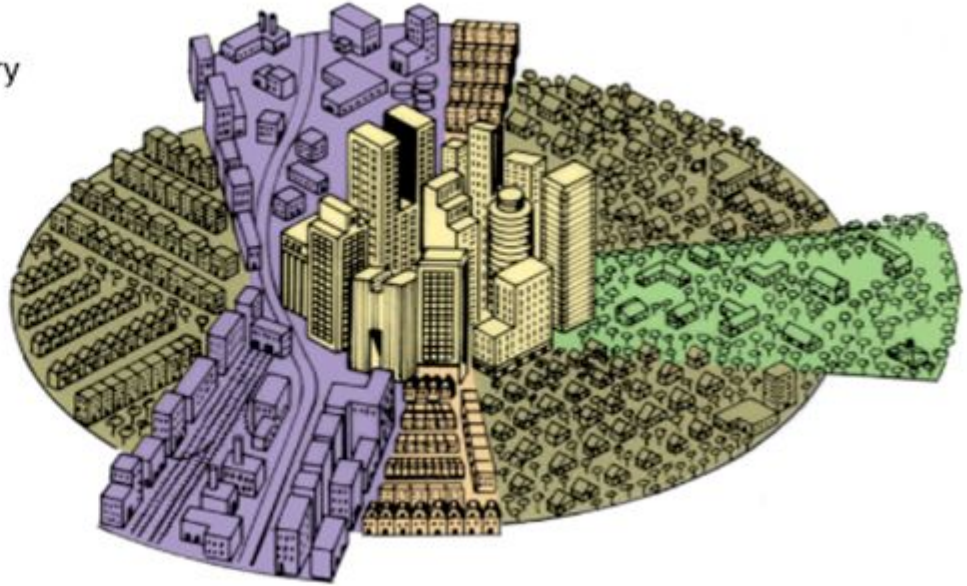
1 Central business district
2 Zone of transition
3 Zone of independent workers' homes
4 Zone of better residences
5 Commuter's zone







1. Central business district
2. Transportation and industry
3. Low-class residential
4. Middle-class residential
5. High-class residential



•Stresses the importance of transportation corridors. Sees growth of various urban activities as expanding along roa
rivers, or train routes.

Intelligent Asset Management
Smart Grids & Energy Management
EVs & Connected Vehicles
Water Metering & Management
Smart Living & Building Automation
Connected Healthcare & Wellness
Public Safety & Security

"You want to be able to monitor, measure, and control your services & assets to gain better outcomes for people"

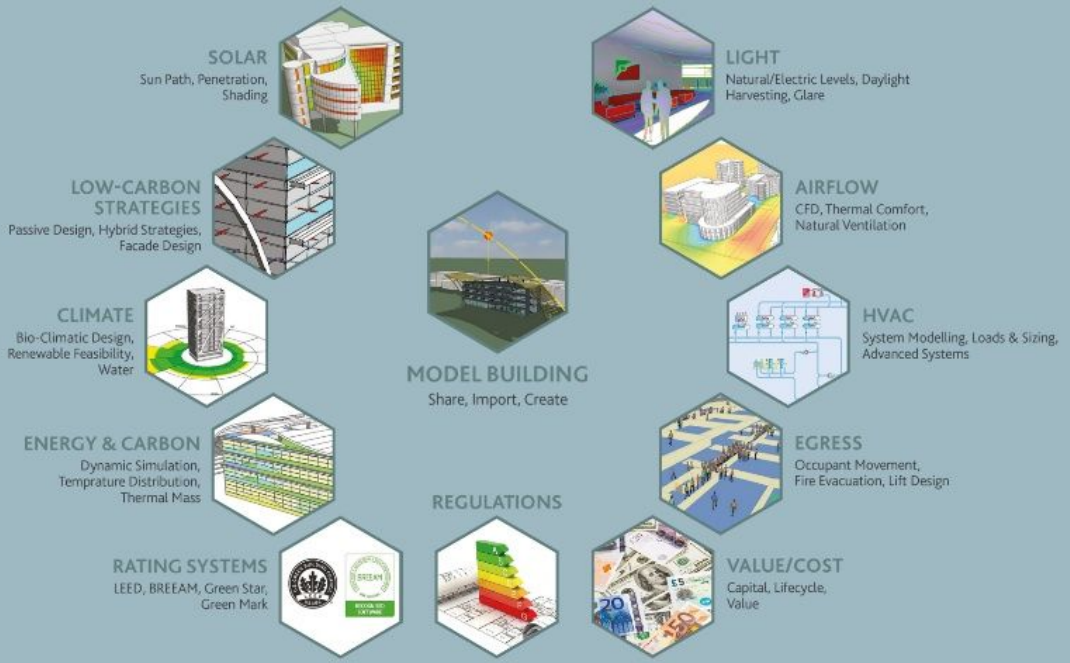
Air Quality Sensor

Noise Monitor

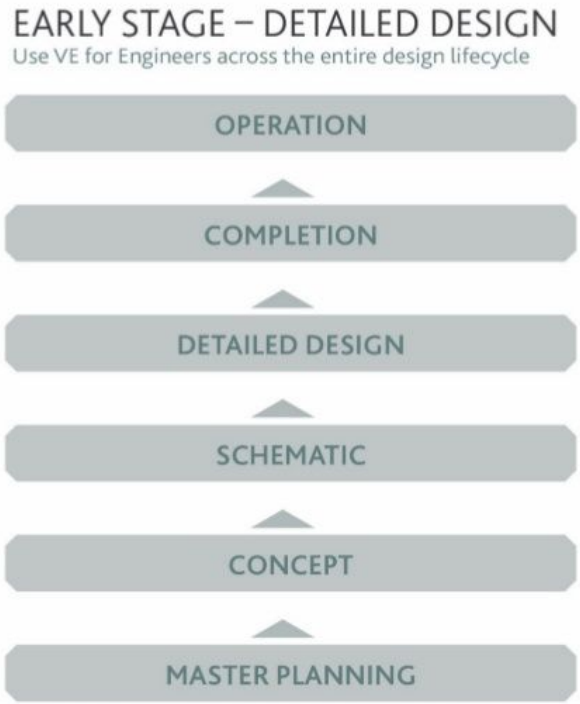
NYC Smart Bikes

Flood Sensors Oxford

VIRTUAL ENVIRONMENT



Who is the typical building simulation client?

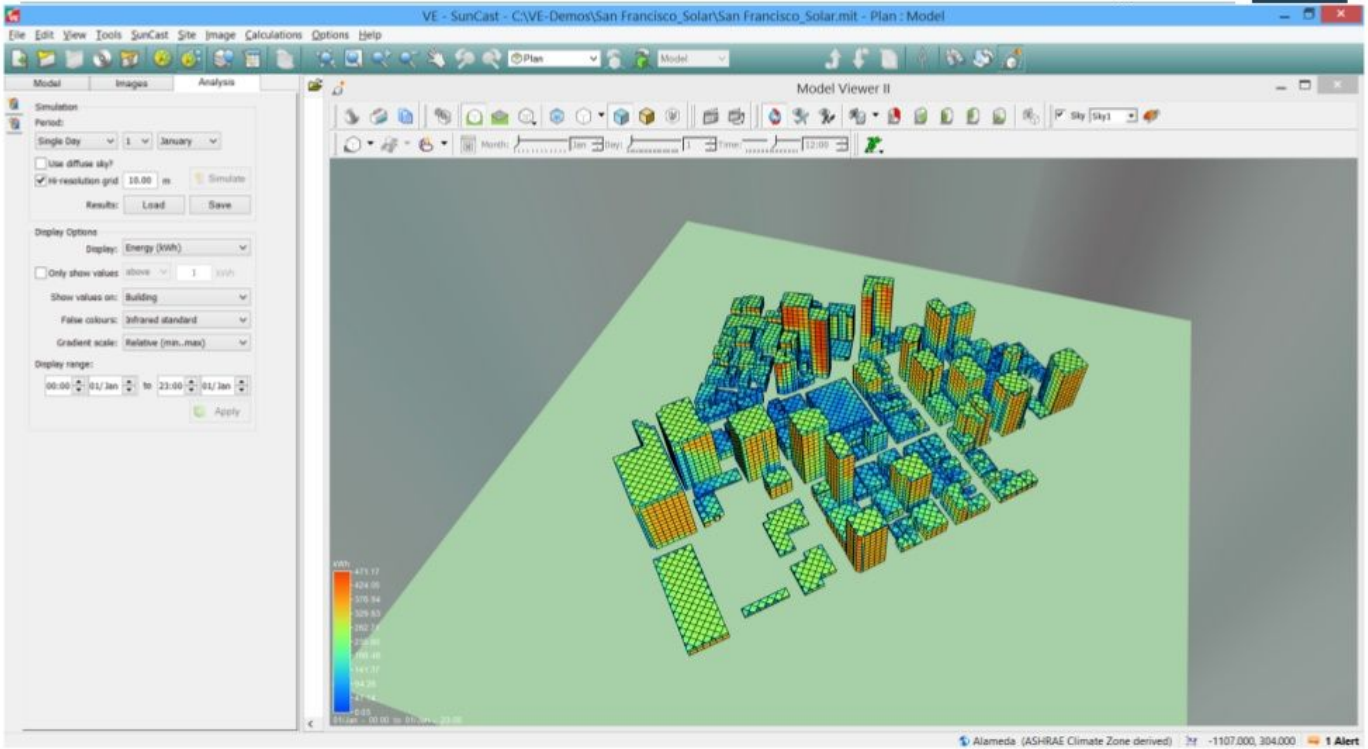


ARCHITECTURAL
- Designers
- Architects
- Master planners
- Urban designers
- Interior Designers

ENGINEERS
- HVAC
- Mechanical
- Electrical
- Building Physics
- Other “green” rating systems

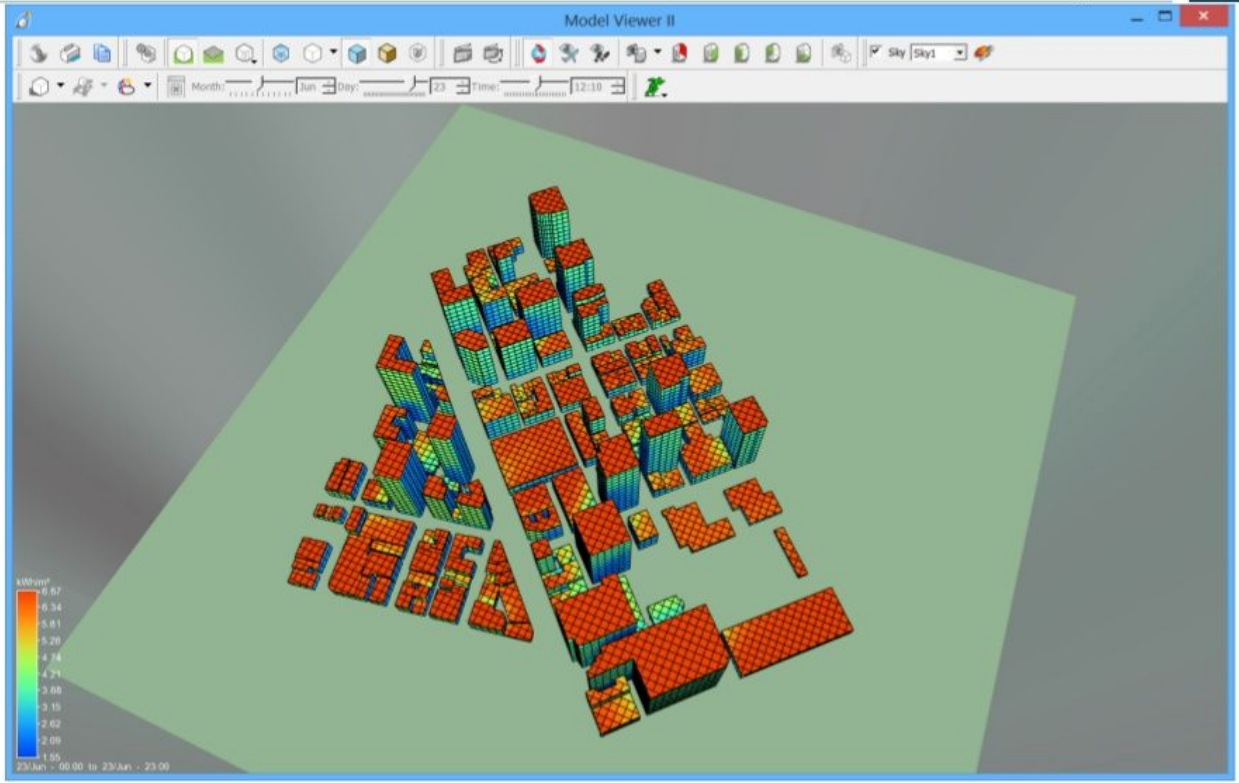
GREEN CONSULTANTS
- BREEAM
- LEED
- DGNB
- Estidama
- Other “green” rating systems

Surface Solar Radiation: Winter Day



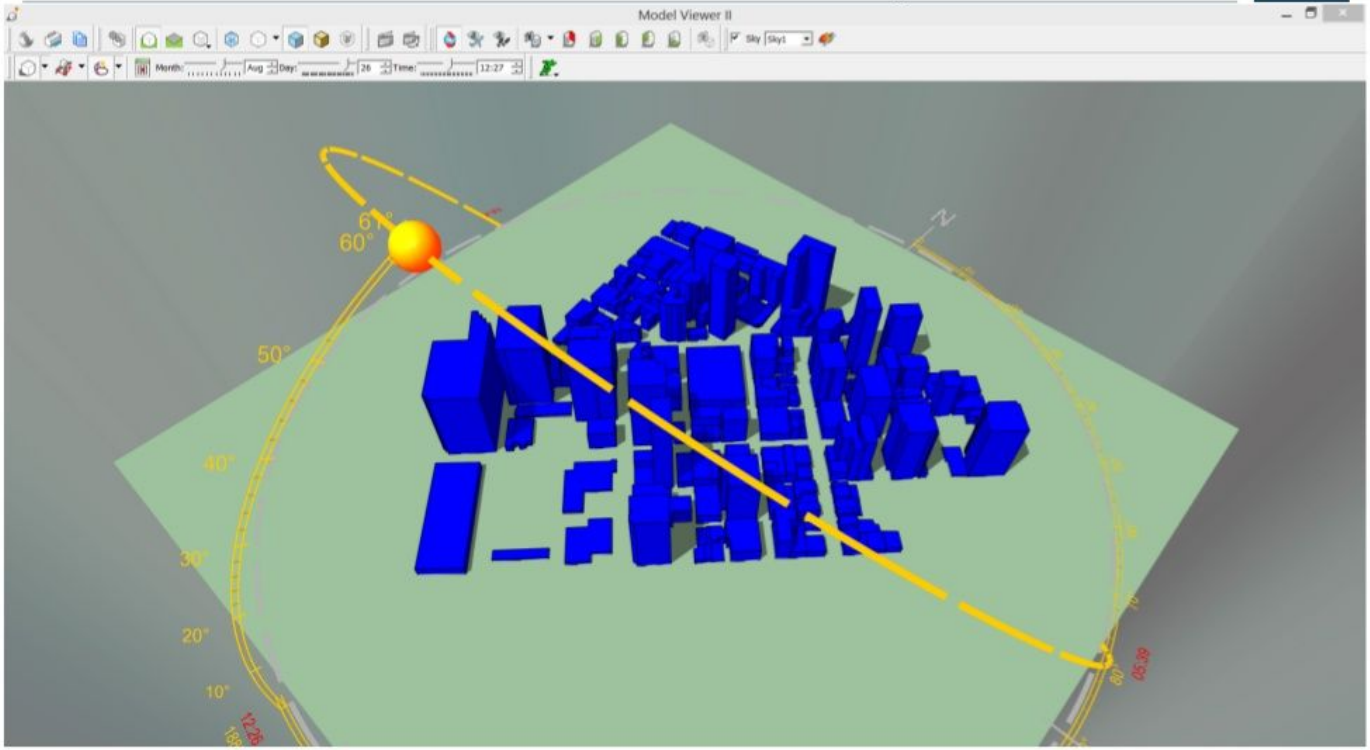
Surface Solar Radiation: 15 January (Red High, Blue Low)

Surface Solar Radiation: Summer Day



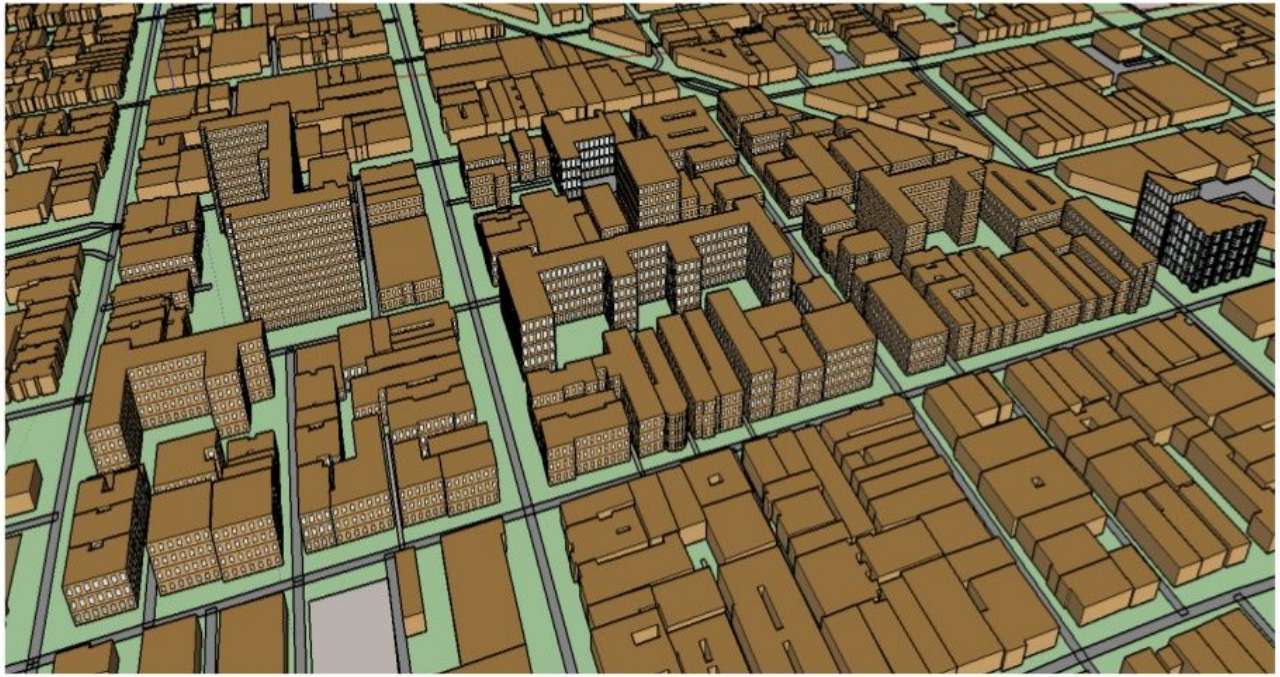
Surface Solar Radiation: 23 June (Red High, Blue Low)

Solar Shadow Study



Shadow studies

Energy Analysis

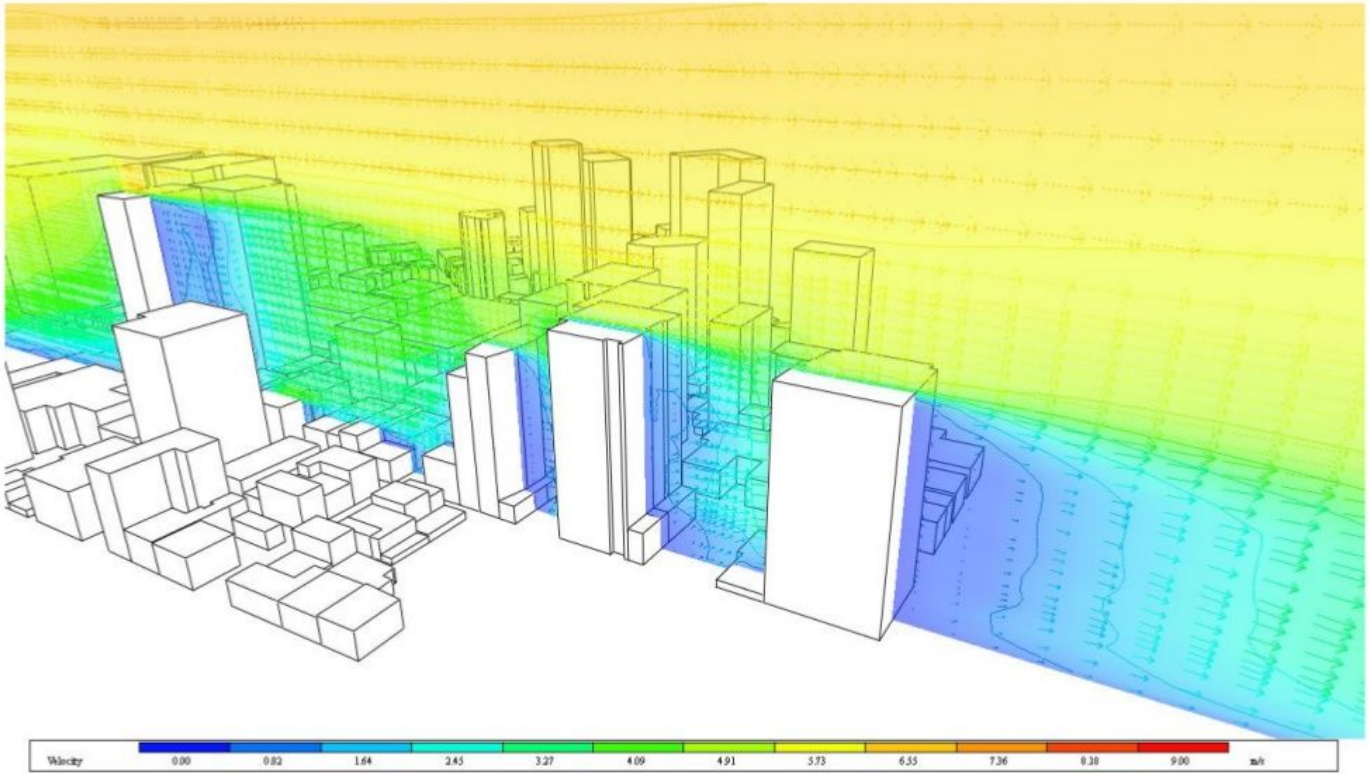


District buildings modelled in more detail

Energy Analysis

Define buildings by spaces types for general analysis

VE-Pro: External Air Flow



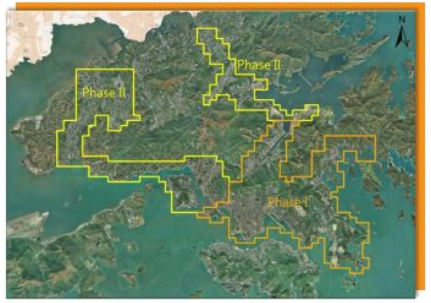
Digital Cities

Combine mapping, building, civil engineering, utility and other 3D data into accurate models that can be visualized, analyzed and shared

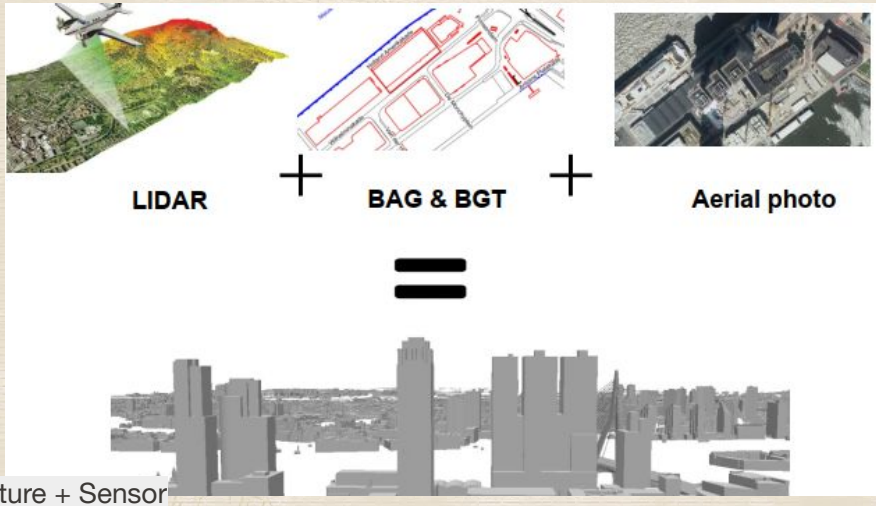
(1) 3D Data Capture / Data Collection

(2) 3D Data Standards and Modelling

(3) 3D Data Sharing



Project Areas



Mesh Models

3D Textured Mesh Model

Data Explosion Location + Feature + Sensor Point Cloud + Realistic Mesh + Semantic Model + Volumetric Data + Live Data + Visualization + Simulation + IoT + Analytics + …

Process for Building Infraworks Model

PHASE I

IMPORT EXISTING GIS DATA FOR PROJECT AREA

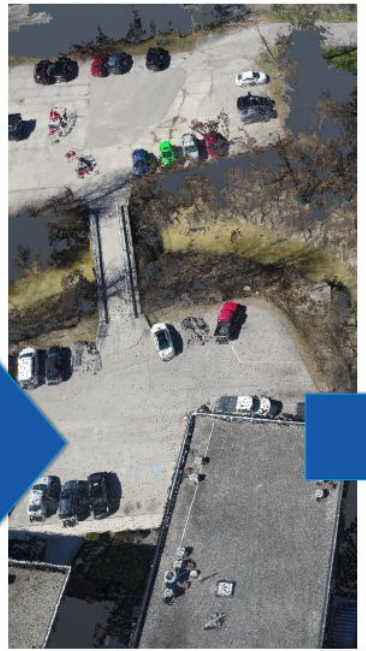
Topography, Roads, Parking Lots, Streams, Buildings, Etc

PHASE II

IMPORT REALITY CAPTURE POINT CLOUDS

UAV Data

Laser Scan Data



PHASE III

ADJUST ELEMENTS TO MATCH & ADD DETAIL

Road & trail alignment, building façade detail, etc.

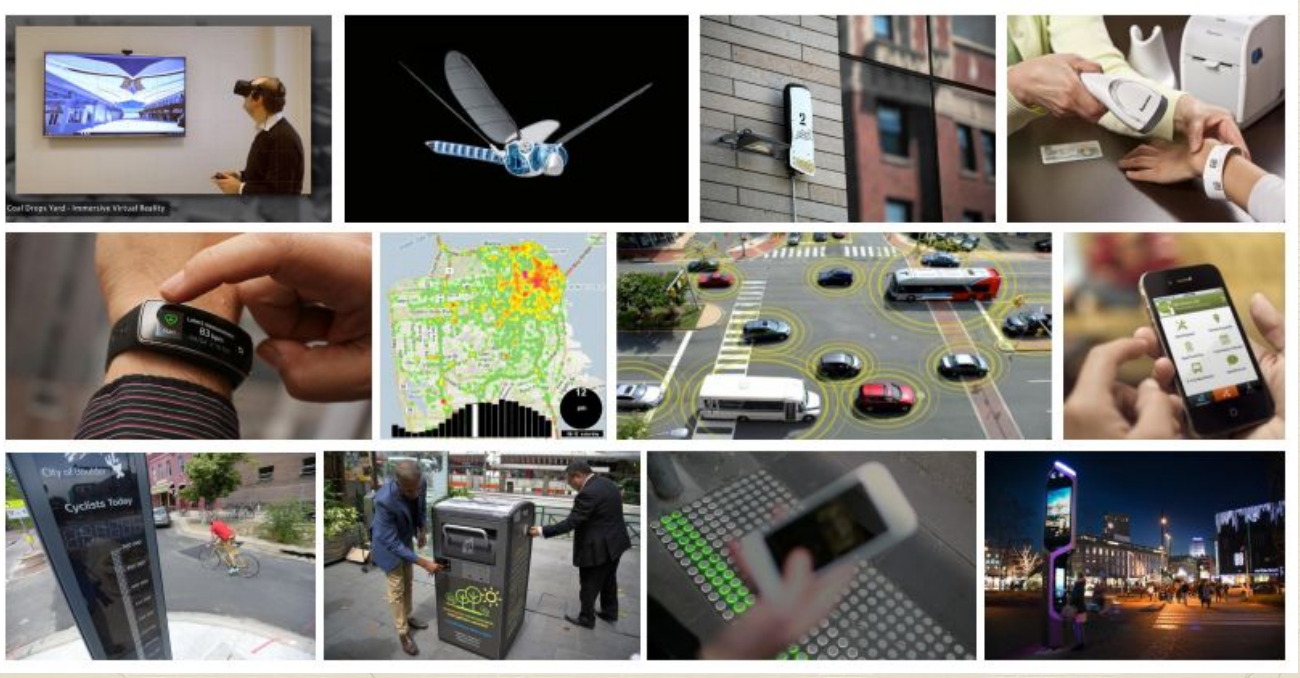
PHASE IV

ADD TRAIL FEATURES TO MODEL

Bike path, light poles, cars, people, vegetation, Etc

TruesenseD
– All rights
preserved

These new smart cities are likely to **be powered**, by **seven technologies**
that **The World Bank believes** will disrupt and transform **how cities deliver services to their citizens**



5G mobile networks,

Blockchain

Artificial intelligence

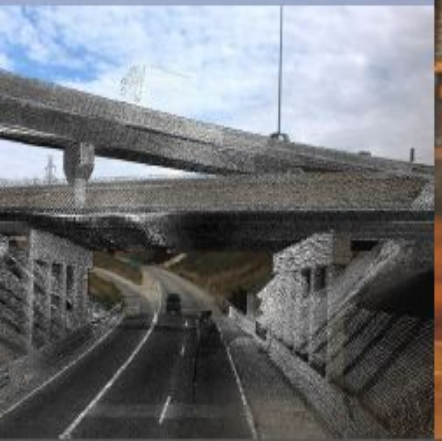
Autonomous vehicles

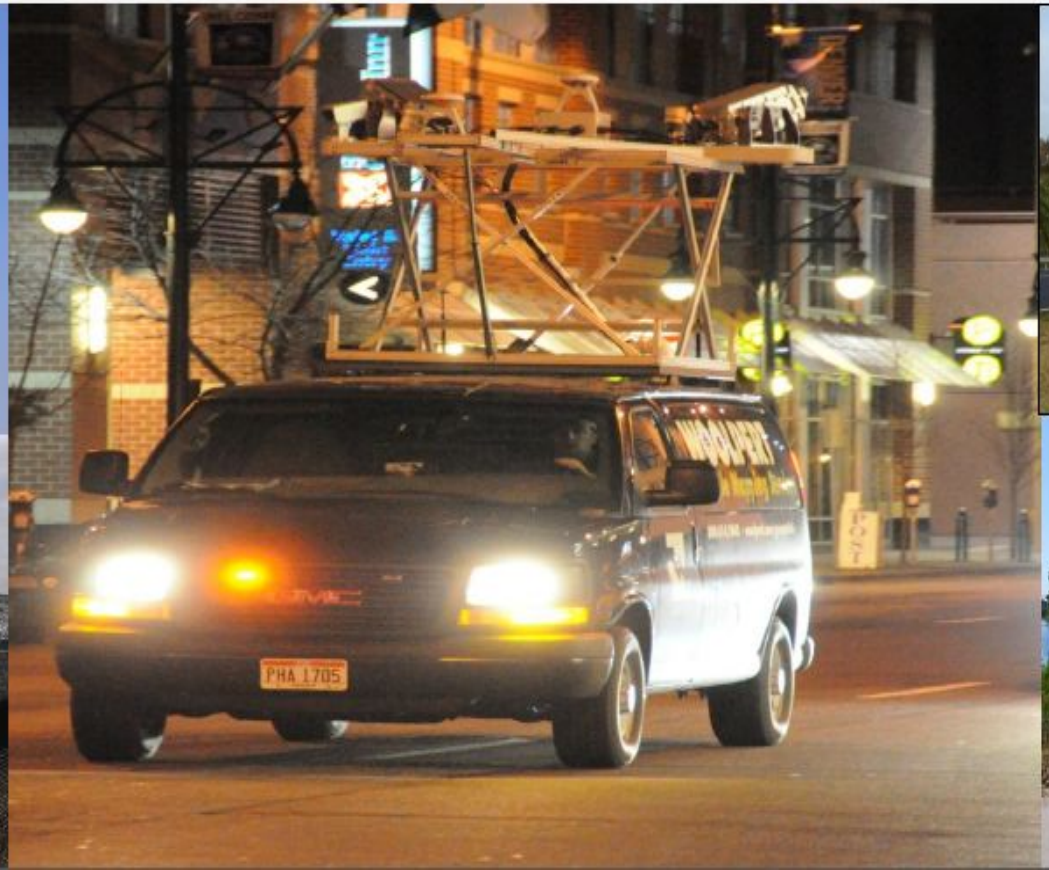
Low-cost space exploration and micro-satellites

Biometrics

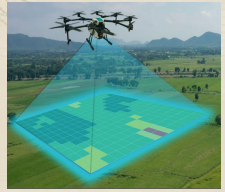
Drones

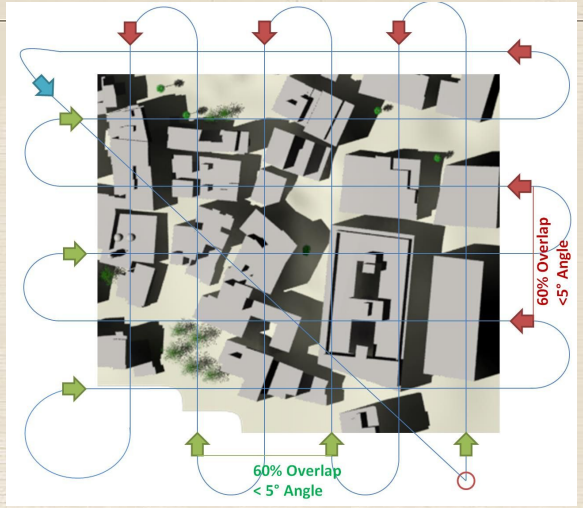
3D Survey Integrated Mapping using LiDAR-Static/Mobile/Aerial Scanning with Supplemental RTK GPS/Digital Leveling/TS/UAV Existing Conditions

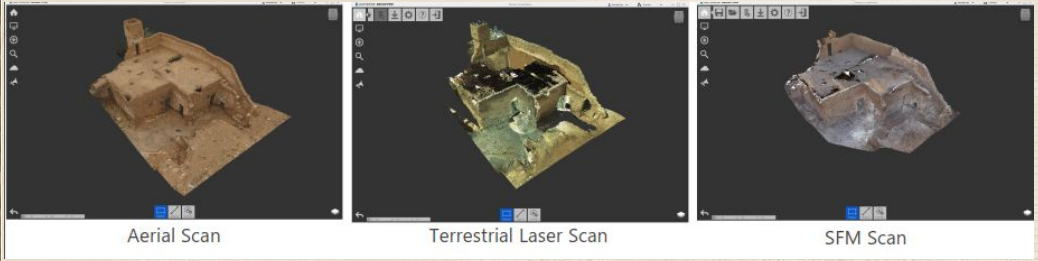




Create 3D Digital Cities Using Drones

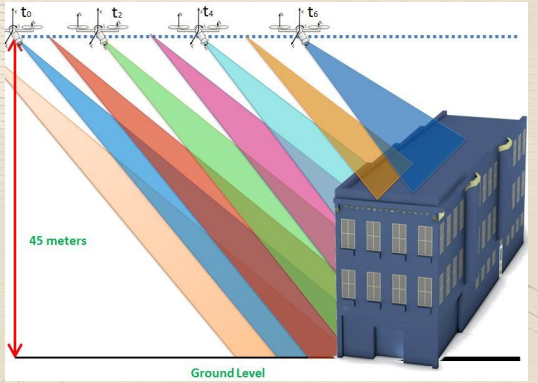






Satellite image +/- 30 cm

FalconViz drone image +/- 2 cm

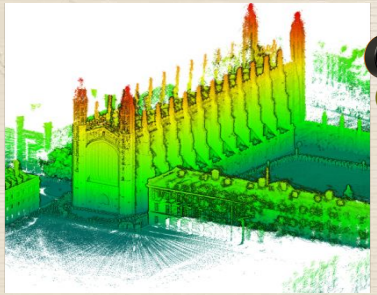


FalconViz LLC - – All rights preserved

3D Digital City – Drone Based

FalconViz LLC – All rights preserved

DRONE AND VEHICLE BASED SCANNING AND CAMERA DEVICE



(DRONE AND VEHICLE BASED SCANNING AND CAMERA DEVICE)

TOPCON

Bentley

CONTEXT CAPTURE

Reality modeling is the process of capturing the physical reality of an infrastructure asset, creating a representation of it, and maintaining it through continuous surveys. Bentley's reality modeling software, ContextCapture, provides you with real-world digital context in the form of a 3D reality mesh.

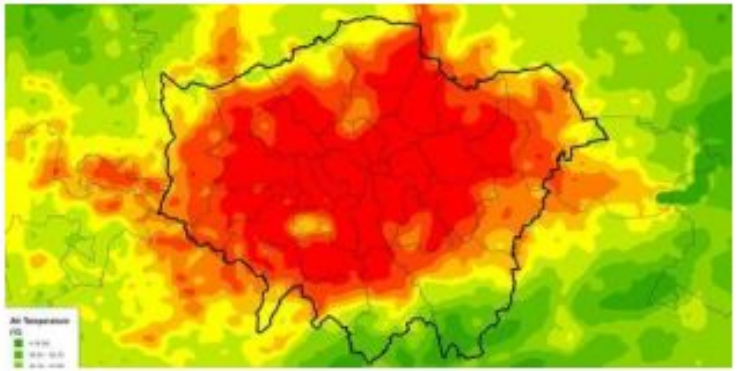
COLLAGE

Post-processing software for Topcon's mass data solutions

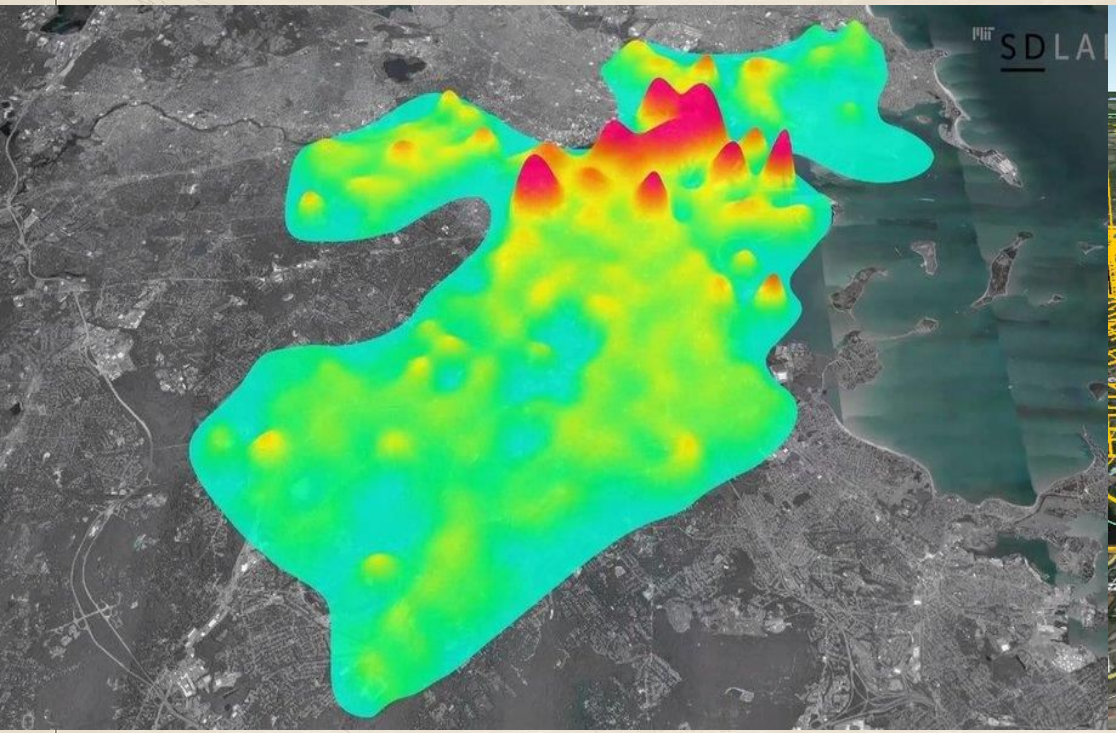
Processes the raw data for the following systems:

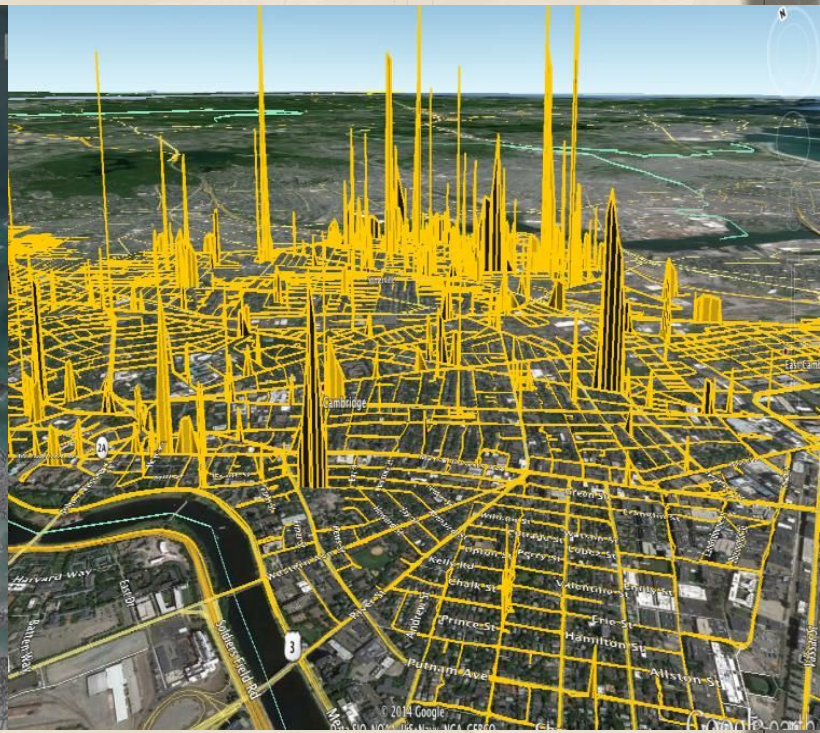
IP-S3 Mobile Mapping System:

Monitoring performance across the city – via the model and linked dashboards



Boston smart city heat and gas leaks map





https://www.edf.org/climate/methanemaps/city-snapshots/boston

https://www.google.com/maps/d/u/0/viewer?mid=1u2rultCwcVDMepvD0PDrRfzv6n-jQcL4&ll=42.516819591234%2C-73.20718368088725&z=12

dashboard.leedsdatamill.org/canvas/leeds-city-council

LEEDS CITY DASHBOARD

Toolbox

Gallery

Weather
5-day weather forecast for Leeds

Day Night Tue 6 Jun

High: 13° Low: 10°

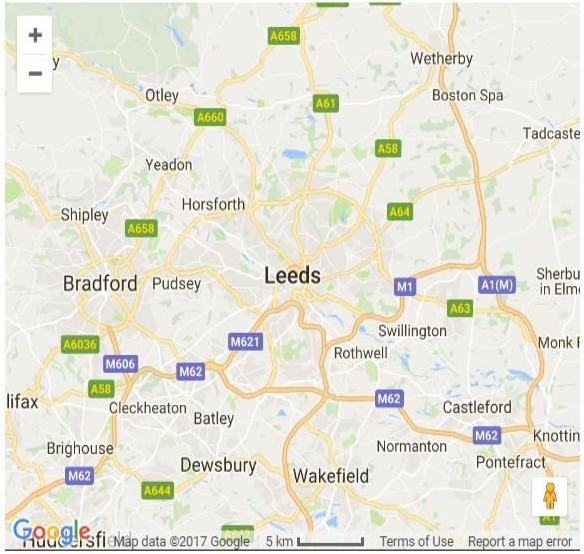
Heavy rain

Chance of rain: 85% | UV Index: 2 | Humidity: 88%

Wind Direction: W | Wind Speed: 20 mph

Author: Ste Allan

Pedestrian Accident Locations
Concentrated locations of accidents involving pedestrians



Author: Liam Bolton

Leeds Footfall Trends
Weekly footfall stats for Leeds City Centre

Figures for the week commencing Mon, 3rd October 2016 and ending Sun, 9th October 2016.

Week 41
Footfall Total
1.40m

Previous week -6%

Same week in 2014 11%

Same week in 2013 11%

2015 Weekly Average 13%

Author: Simon Zimmerman

FOI & EIR
Number of FOI & EIR Requests

Dec-14

FOI & **EIR** Requests received 95

Response time

Within 20 days 89.6%

Over 20 days 10.4%

Full Disclosure	Partial Disclosure	Withheld
19	81	11

Author: Nathan Smith

TUESDAY

6 TH

JUNE 201

Leeds Data Mill Twitter Feed
What are we tweeting about?

DATA MILL NORTH @DATA MILL NORTH

Nice shout out to the work we're doing at @DataMillNorth, thanks @techUKCEO @ComputerWeekly https://t.co/olrgeCTffl

Leeds Car Parks
Registered spaces available in Leeds

Albion Street

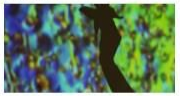
P Albion Street

Leeds Inspired
Music & art events around Leeds

Multi-Sensory Social Extra

5 Jun 2017 10:30am - 12pm

Room 700, Leeds Central Library



A multi-sensory social gathering where new parents can get together in a relaxed yet stimulating environment with their babies. Enjoy light show projections, sound effects, objects to feel and evocative smells to explore. The session will conclude with gentle stories and rhymes. Suitable for pre-crawlers, not suitable for

Author: Nathan Smith

Statutory Notices
Newly added in Leeds

Statutory notices are legally required public notices which inform residents of proposed changes about specific things.

16 Licensing

566 Planning

View Stat Notices

Author: Nathan Smith

Smart City

Community

Social

Economic

Ecological

Location based approach

Digital Twin

Geospatial Data I Spatial Data I Sensor Data I Data

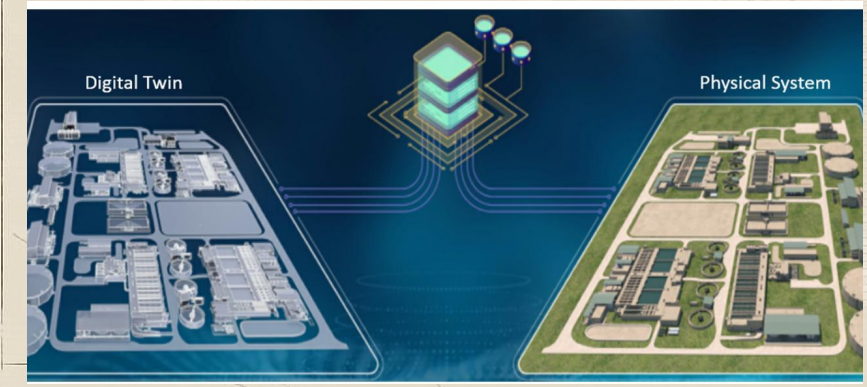
Connecting infrastructure: all roads lead to the Digital Twin

Developing a **digital twin**: **a virtual model** of the infrastructure which will both

monitor infrastructure in real-time

and have **predictive capability**.

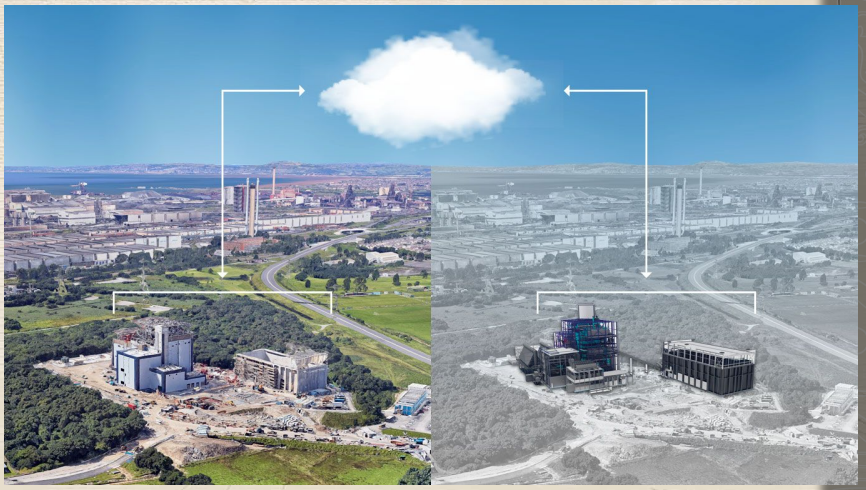
This will help **manage, plan, predict and understand** the infrastructure, delivering resilient, responsive, high-performance systems.



Three demands for useful and modern digital city twin

- It's available through open interfaces
- It's up-to-date all the time
- Extensive data content (not only buildings)

3d Digital Model with Intelligent Data Is essential For Smart Cities



“the Digital Twin”

A digital version of the real world
including physical assets indoors, outdoors, above and below ground.

An integrated approach -multiple contributors, multiple geometries

enables scenario modelling, simulation and analytics

Dynamic and linkable representations of real-world features, supported with strong, persistent identifiers.

Machine readable content, integrated with other views of the real world

> **“The best way to predict the future is to create it.”**
>
> Abraham Lincoln

virtual model of London

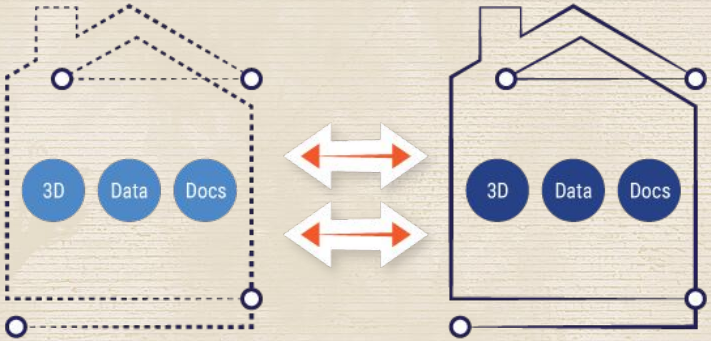
BIM

DIGITAL WORLD

DIGITAL TWIN

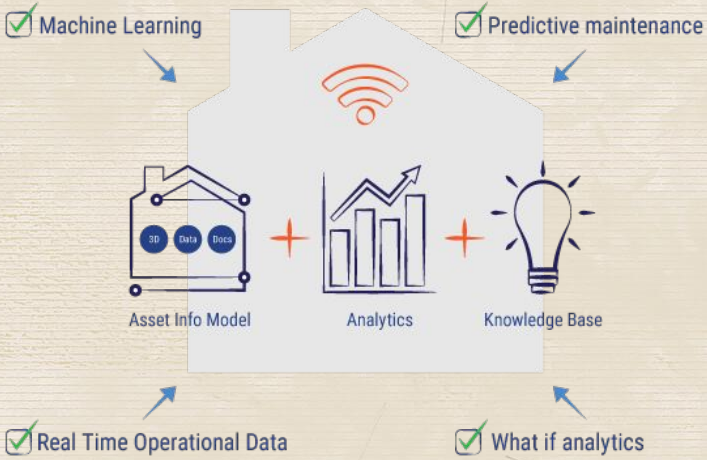
DIGITAL WORLD + PHYSICAL WORLD

STRUCTURED INTEROPERABLE DATA



as - DESIGNED model

as - BUILT model



CONCEPT DESIGN → DESIGN → CONSTRUCTION → OPERATION AND MAINTENANCE → END OF LIFE

The journey towards smart buildings

SIEMENS
Ingenuity for life

< 2010
Traditional building

Domain know-how
+ On-site solutions
+ On-site services

2010
Automated building

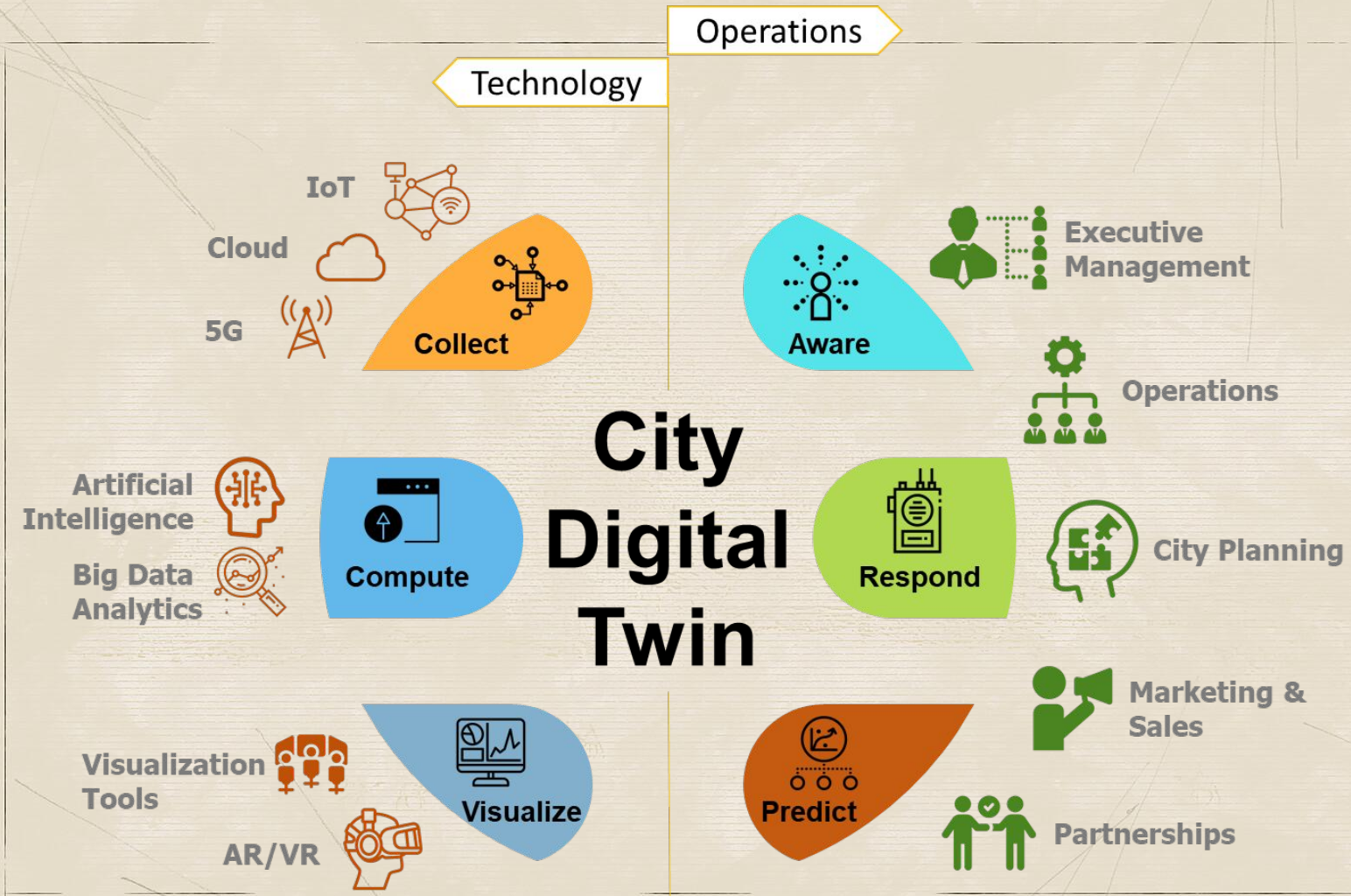
+ Fully integrated management stations and remote connectivity
+ Energy Efficiency

2020
Smart building

+ Automated remote analytics
+ Workplace Experience
+ Building twin

202?
Smart building
Self-adaptive

+ Simulation and artificial intelligence based on Building Twin


Operations
Technology
IoT
Cloud
5G
Collect
Aware
Executive Management
Operations
City Digital Twin
Artificial Intelligence
Big Data Analytics
Compute
Respond
City Planning
Marketing & Sales
Visualization Tools
AR/VR
Visualize
Predict
Partnerships

Orbit 3DM Content Manager

AN INDISPENSABLE STEP IN THE 3D MAPPING DATA CHAIN

Organize & manage

Catalog & Archive

Improve & optimize image and point cloud data

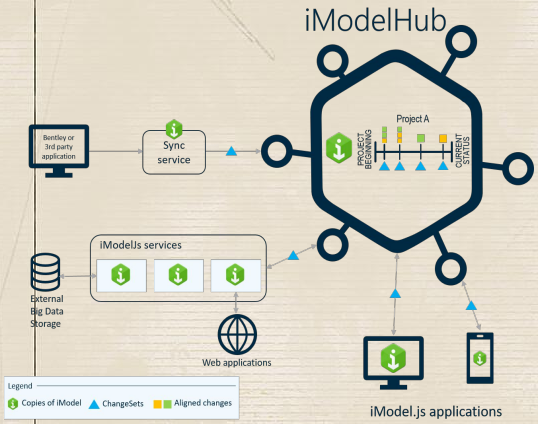
QA/QC

Document and report independent

Deliver ready-made projects after capture

Upload to share online

FEATURES DOCS & DOWNLOADS



https://www.itwinjs.org/

open platform for digital twins

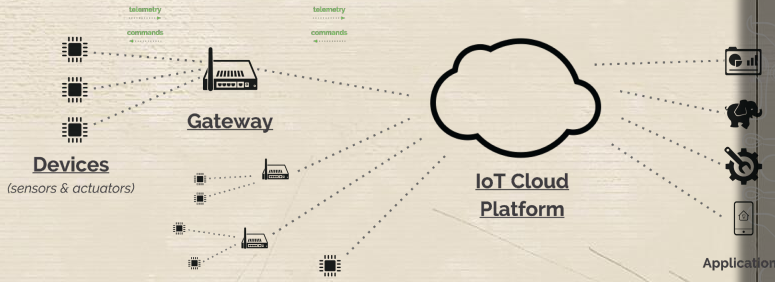
RedBite SOLUTIONS

itemit

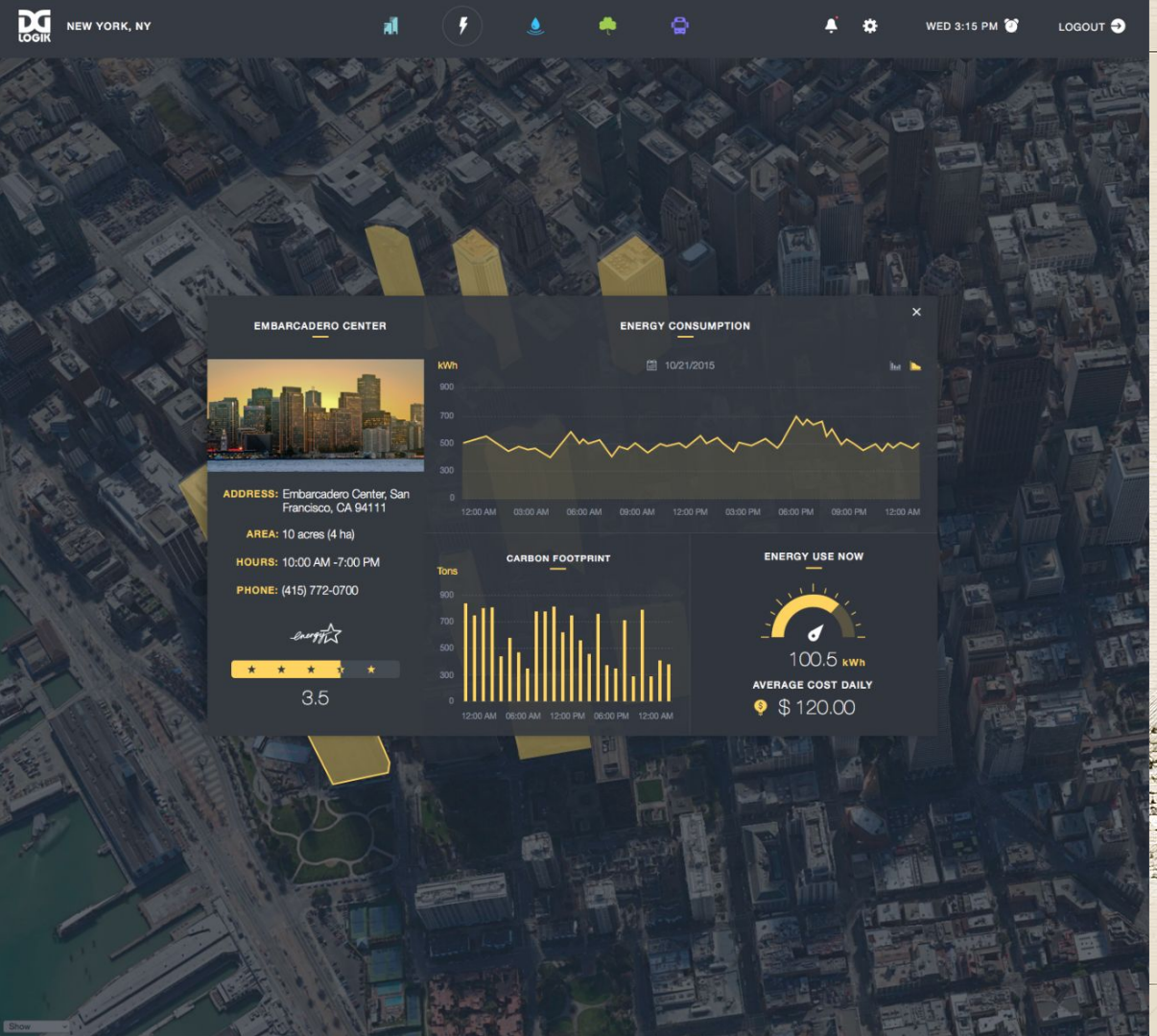
asset management solutions

AssetWise CONNECT Edition

AssetWise - Asset Information Management Software

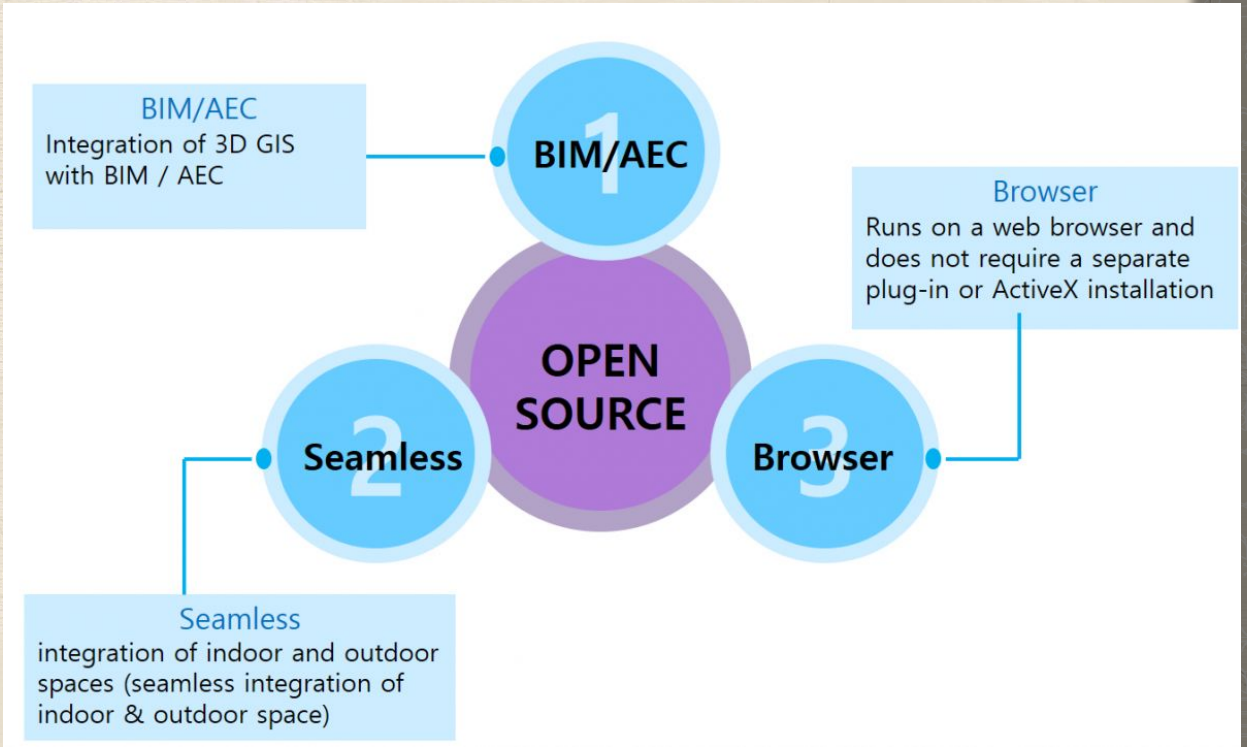


iot sensor platform and devices



https://www.dglogik.com/iot-verticals/smart-cities

mago3d

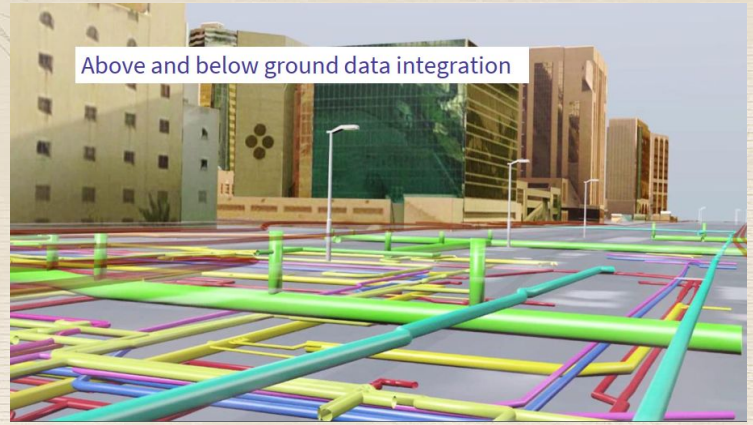


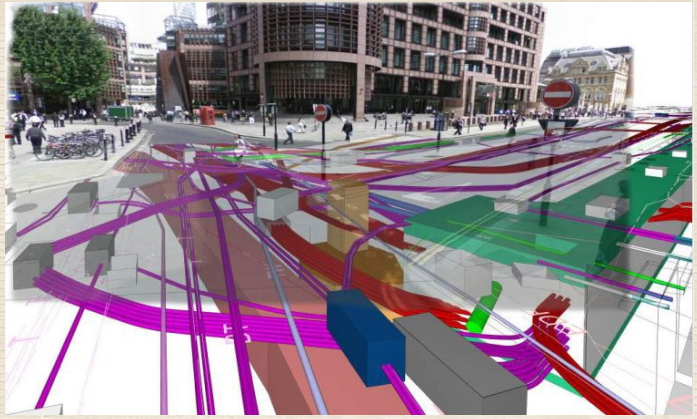
http://www.mago3d.net/homepage/demo.do?viewLibrary=worldwind&lang=en

Oliot is aiming an international standard based **Internet of Things (IoT) Infrastructure Platform**, by extending the code system of GS1 and their standard architecture to support various IoT connectivity and protocols such as bar code, 2D DataMatrix, QR Code, RFID, ZigBee, 6Lo, Bluetooth Low Energy, OneM2M, OCF, etc. Oliot also aims a complete implementation of GS1/EPCglobal standard.

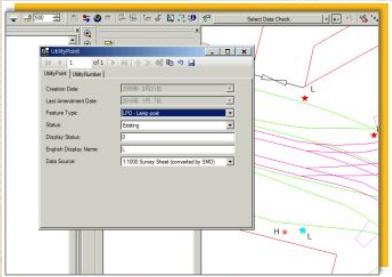
Internet Of Things

IOT





Use Artificial Intelligence (A.I.) for mapping



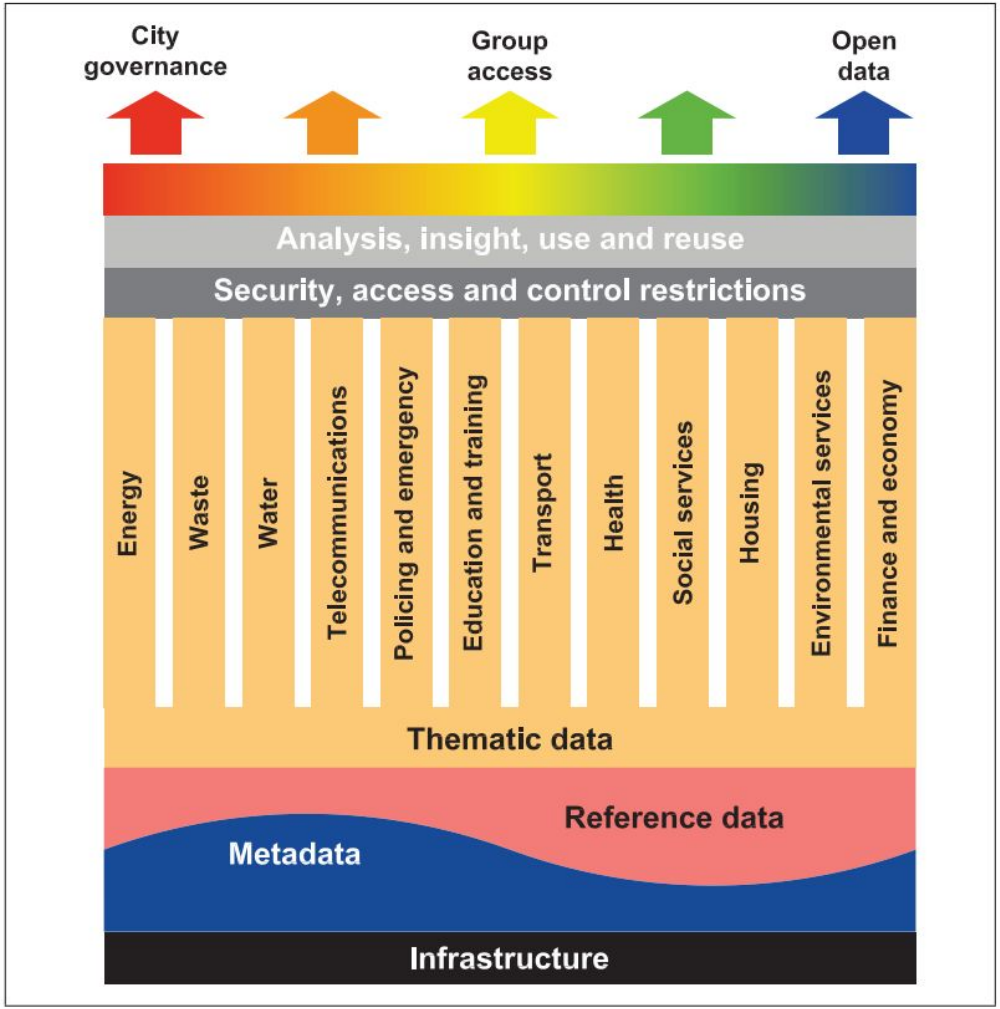
Conventional Feature Extraction by Coding

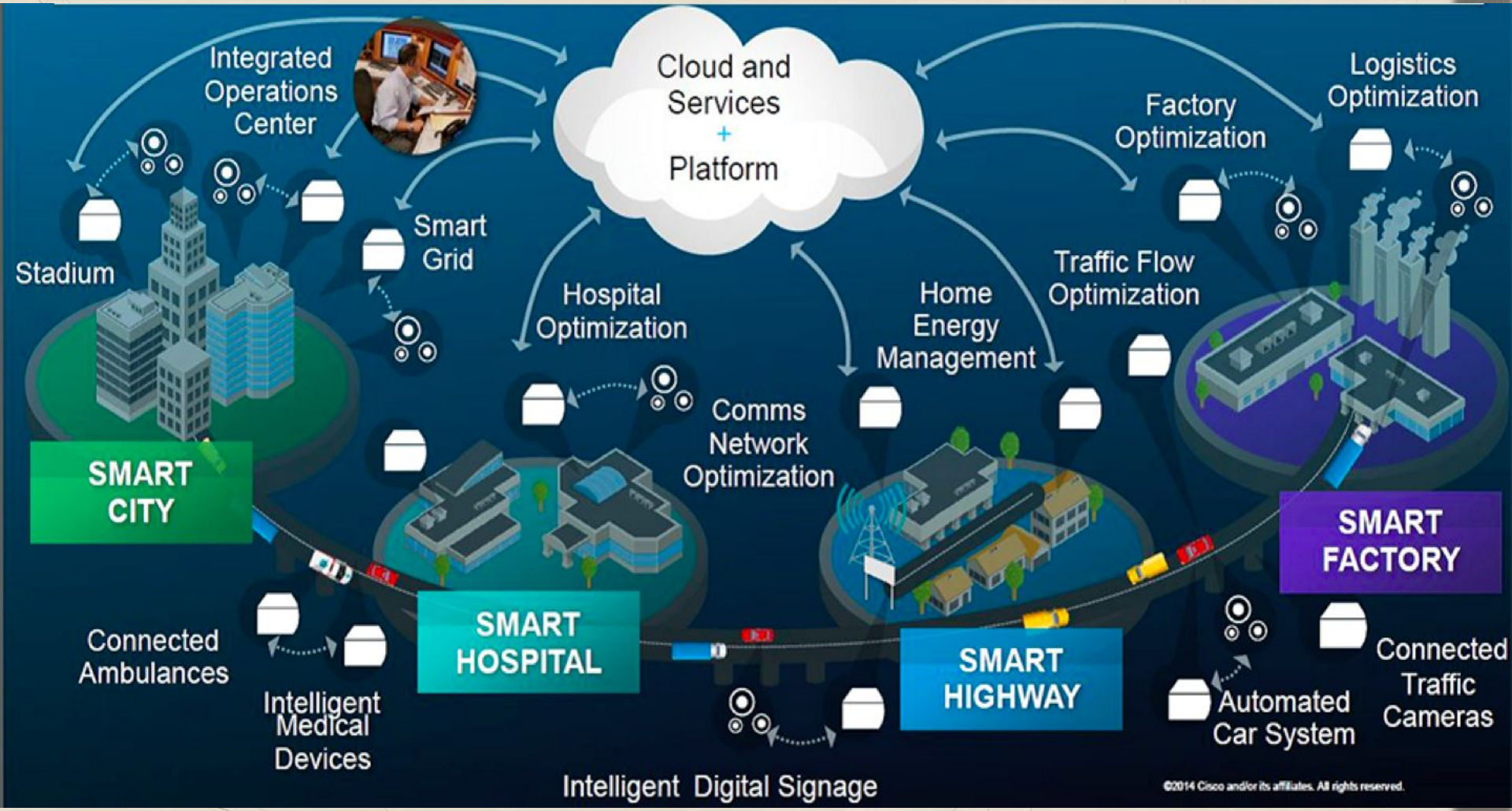
Automatic Feature Extraction by A.I.

There’re basically and originally differences between BIM data and GIS data.

BIM data	GIS data
objects of Buildings	Objects on the Earth
Walls, Pillars, Floors, Windows, Doors, etc.	Roads, Buildings, Mountains, Trees, etc.
Usually created by Human	Usually generated via surveying(and processing)
.RVT, .IFC, and so on .	SHAPE, .GEOTIFF, and so on

Data framework




Integrated Operations Center
Cloud and Services + Platform
Logistics Optimization
Factory Optimization
Stadium
Smart Grid
Traffic Flow Optimization
Hospital Optimization
Home Energy Management
Comms Network Optimization
SMART CITY
SMART FACTORY
SMART HOSPITAL
SMART HIGHWAY
Connected Ambulances
Intelligent Medical Devices
Automated Car System
Connected Traffic Cameras
Intelligent Digital Signage
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City government
More efficient city management

City residents
Services and information

Integrated city management platform

Supervision and coordination

Information sharing

Incident management

Management and optimization

Business intelligence

Decision support

Traffic management

Public transport

Electric vehicles

Events and emergencies management

Weather and emissions

Security

Integrated city management platform

Building Information Model : A Building Information Model or BIM utilizes cutting edge **open standard digital technology**

to establish a **computer generated representation** of all the physical and functional characteristics of a facility and

to establish its related **project/life-cycle information**, and

is intended to be a **repository of shared information** for the facility owner/operator to use and maintain throughout the life-cycle of a facility.

How are we using 3D Models?

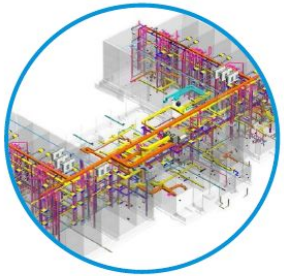
VISUALISATION

- Design / Drawing Production
- 3D Details
- CGI
- Virtual reality

CLASH DETECTION

- Clash avoidance
- Cost Avoidance

MODEL COORDINATION



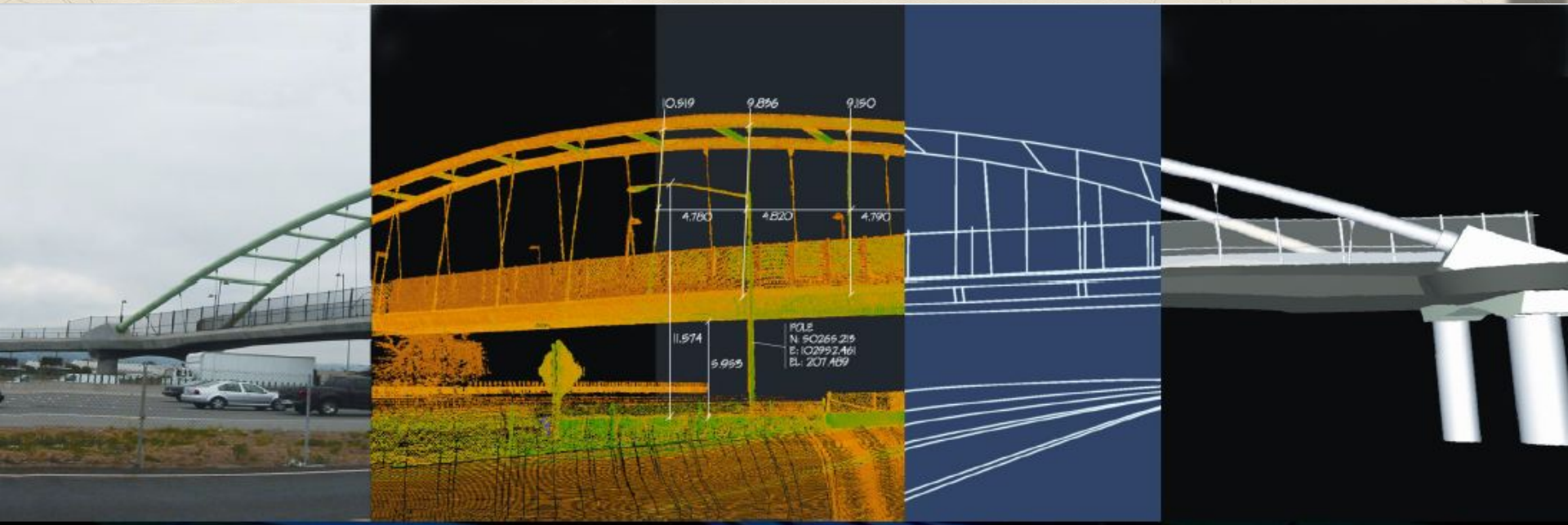
- Digital Twin
- Fully coordinated 3D Project

4D MODELLING

- Construction Simulation
- Logistic

5D MODELLING

- Quantity take-off
- Costs



Georeferenced

Hi-res Digital

Images

3D

XYZ Return

LAS Point Clouds

2D -3D Feature Lines

3D DTMs-TINs

X-Sections

3D

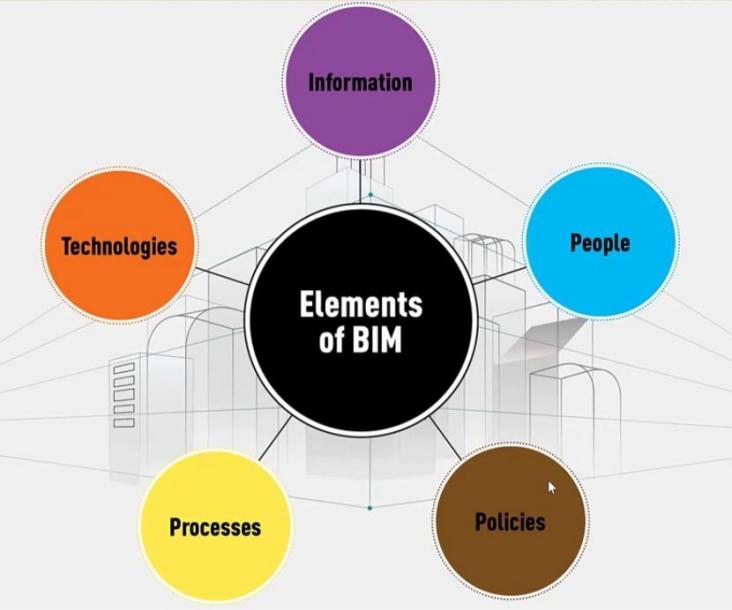
CIM-BIM

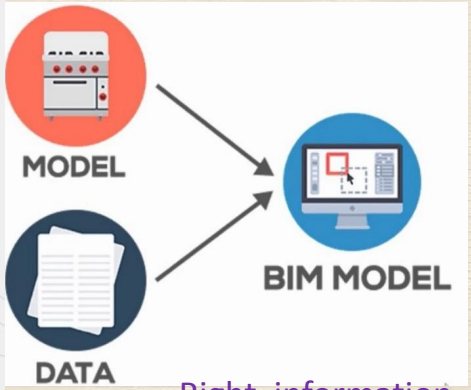
DSMs

BIM

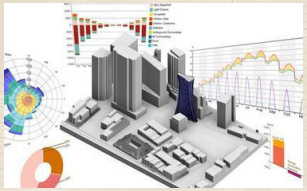
- BIM stands for **B**uilding **I**nformation **M**…..

- Model (smart **composition** of **objects + information**)





Right information,
in the right form,
from the right person,
at the right time



- Modeling

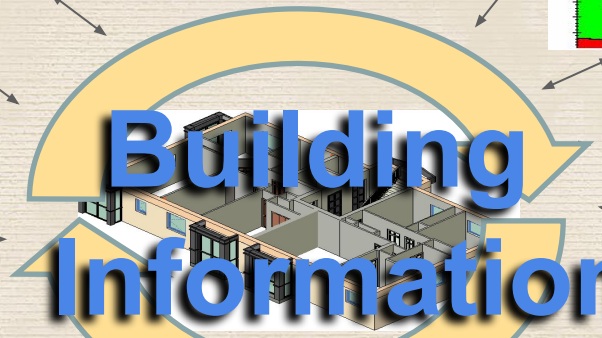
The **process** of Sharing information about building ,

Defining the **Execution Plan Implementation** the process of the **C D E**.

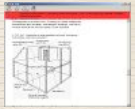
-begins with creating an intelligent 3D design model

-uses that model to facilitate coordination, simulation, and visualization,
- helping owners and service providers improve how buildings and infrastructure are planned, designed, built, and managed.

Lifecycle Information View



Laws and regulations
-Building regulations
-Building specifications



CAD software
-Drawings,
calculations

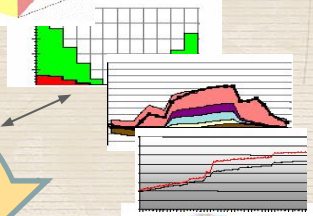
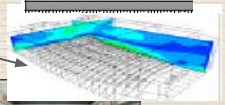
VRML
-Visualisation, 3D models

ineer,…

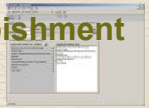
Knowledge databases
-Best practise knowledge
-Own practice

Briefing
-Functional req.
-Estimates
-Conditions
-Requirements

Simulations
-Comfort
-Ventilation, heating
-Life cycle cost
-Light, sound
-Insulation
-Fire, usage
-Environment
-Life time predictions

Demolition, refurbishment
-Rebuild
-Demolition
-Restoration



Facility management
-Letting, sale, operations
-Maintenance
-Guarantees

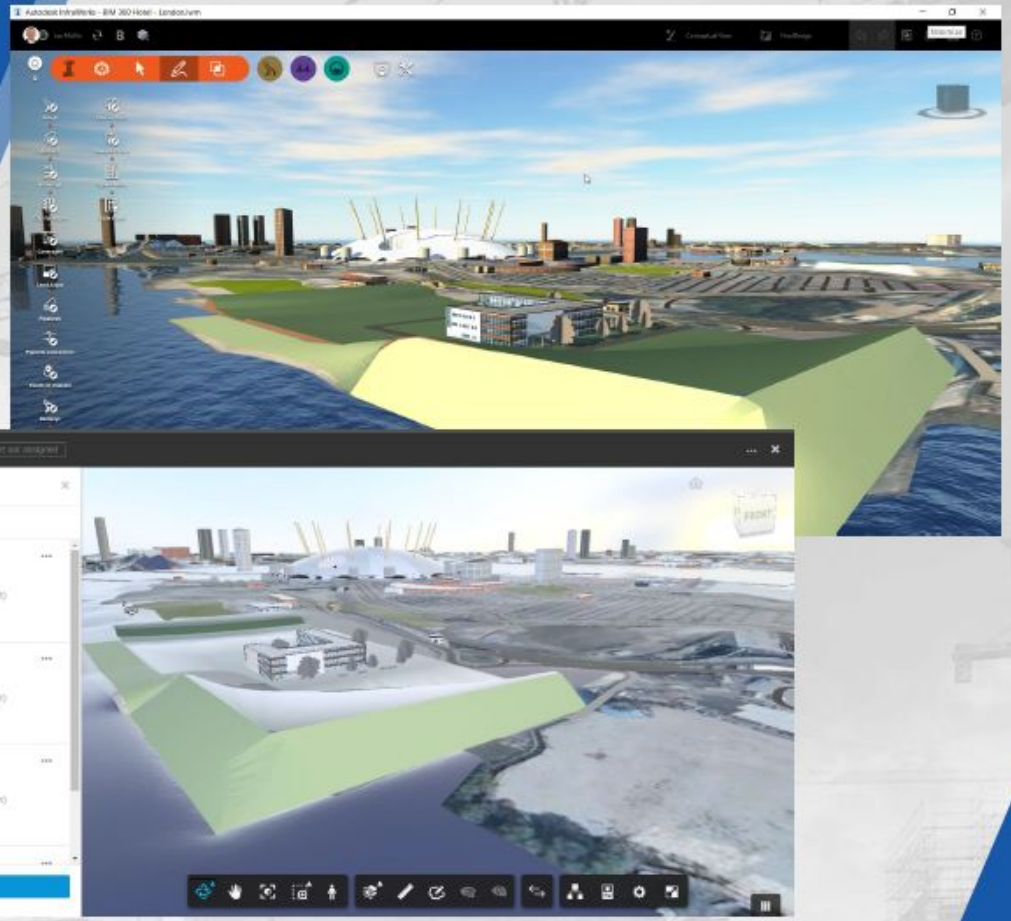
Construction management
Scheduling

Specifications
-Specification sheets
-Classification standards
-Estimates, accounting

Procurement
-Product databases
-Price databases

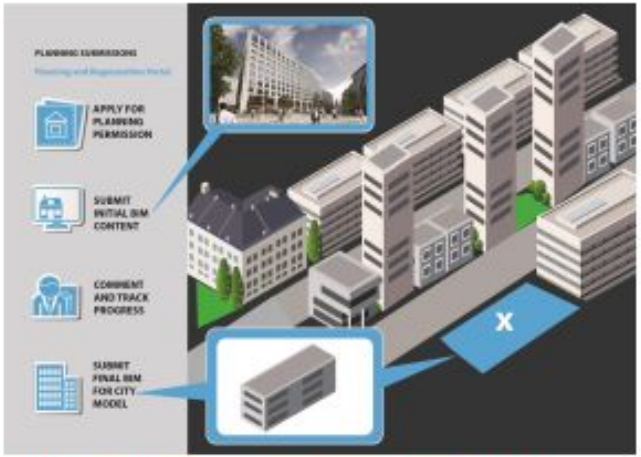
VIEW MODEL IN CONTEXT

- Load Revit model published into BIM 360 into Infraworks for context
- View different landscaping and traffic scenarios
- Create Markup and Issues on the design in context



AUTODESK

Better more informed planning decisions using the model

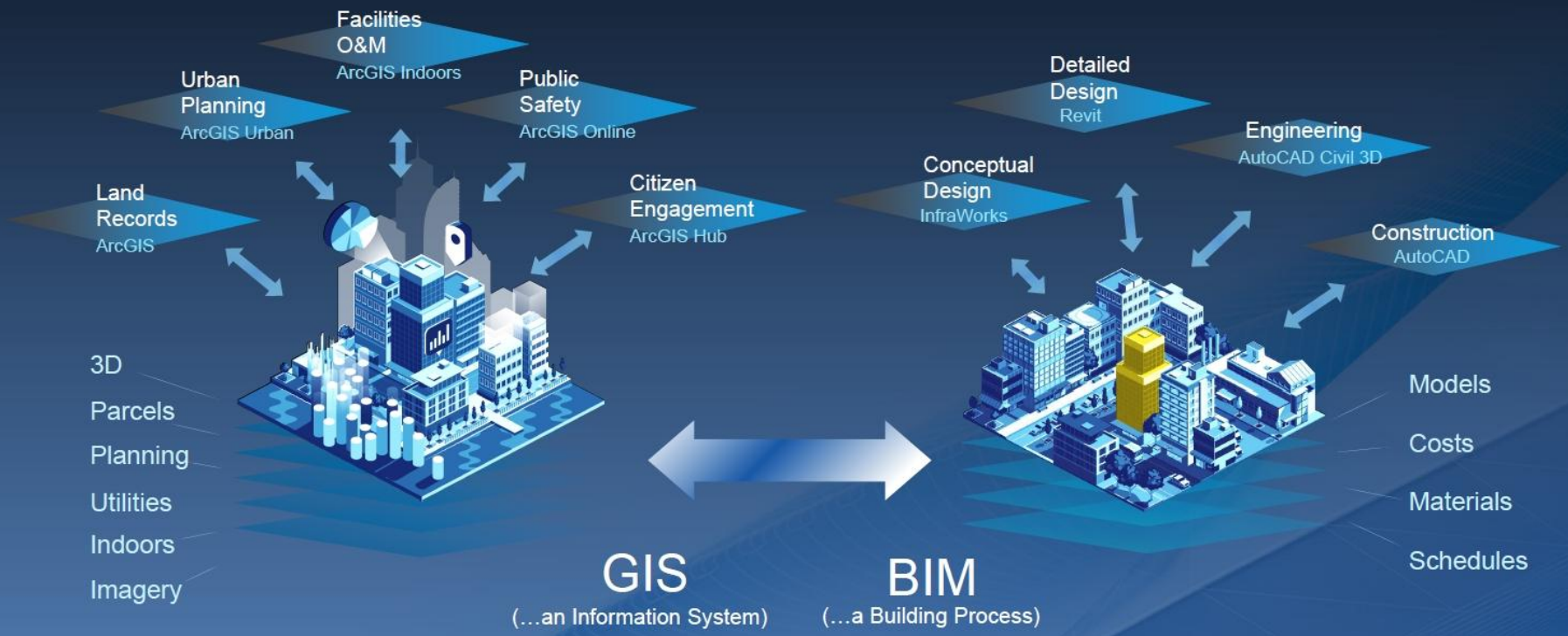


At planning the concept model is placed in the model

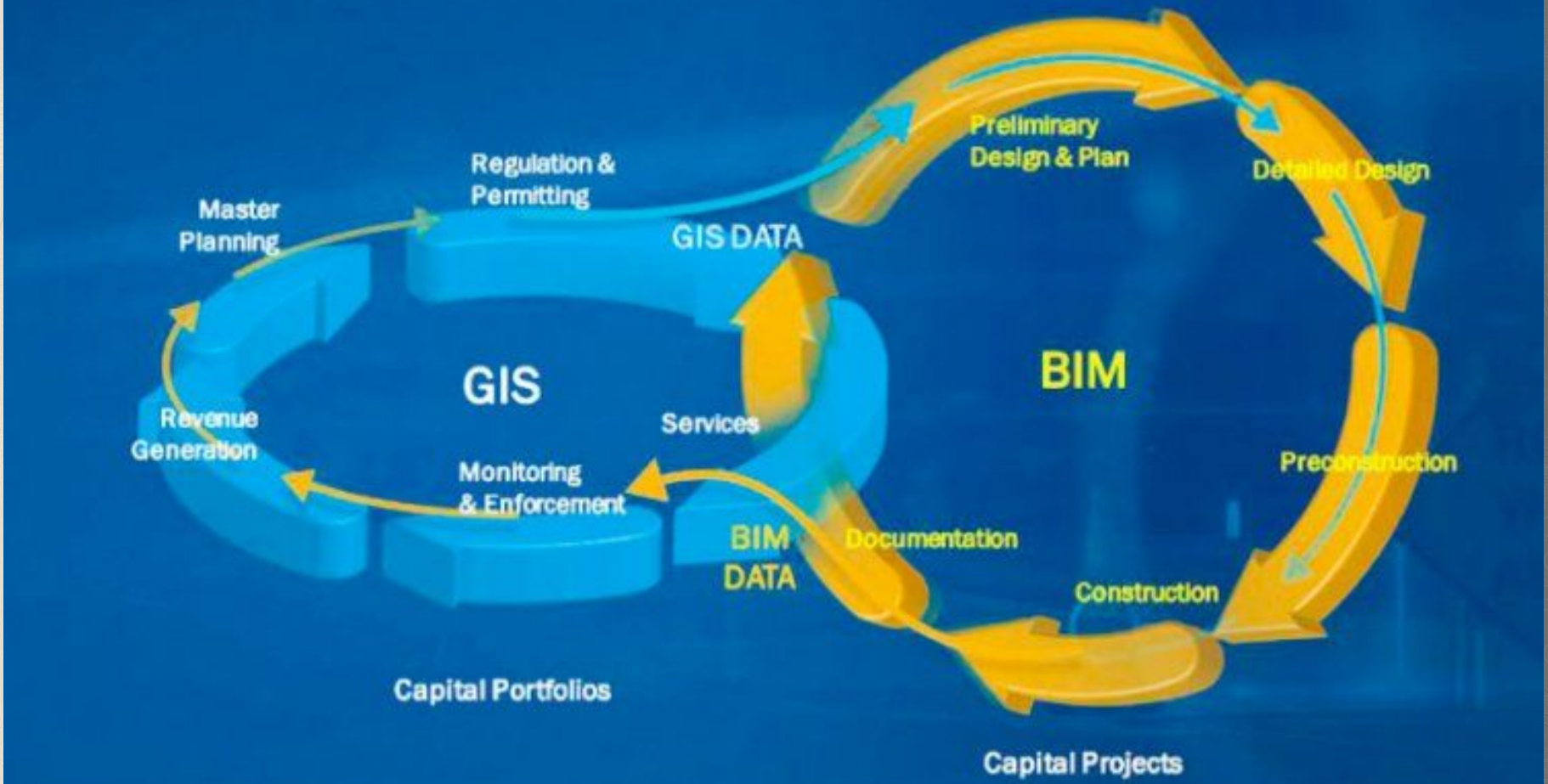
The model helps planners to understand the impact a development will have

Smart Cities and Infrastructure with GIS and BIM

Technology integration leads to smarter more efficient cities

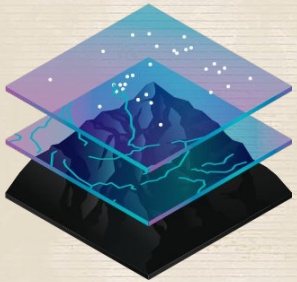


BIM and GIS Workflows Are Happening Continuously in Smart Cities

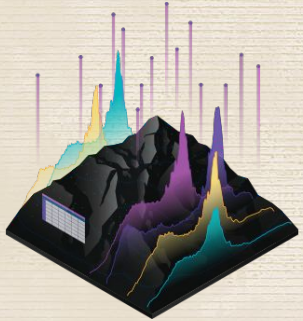


Geographic Information System (GIS)

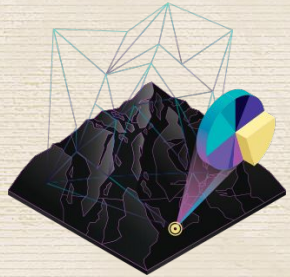
is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this unique capability, GIS reveals deeper insights into data, such as patterns, relationships, and situations—helping users make smarter decisions.



Maps



Data



Analysis

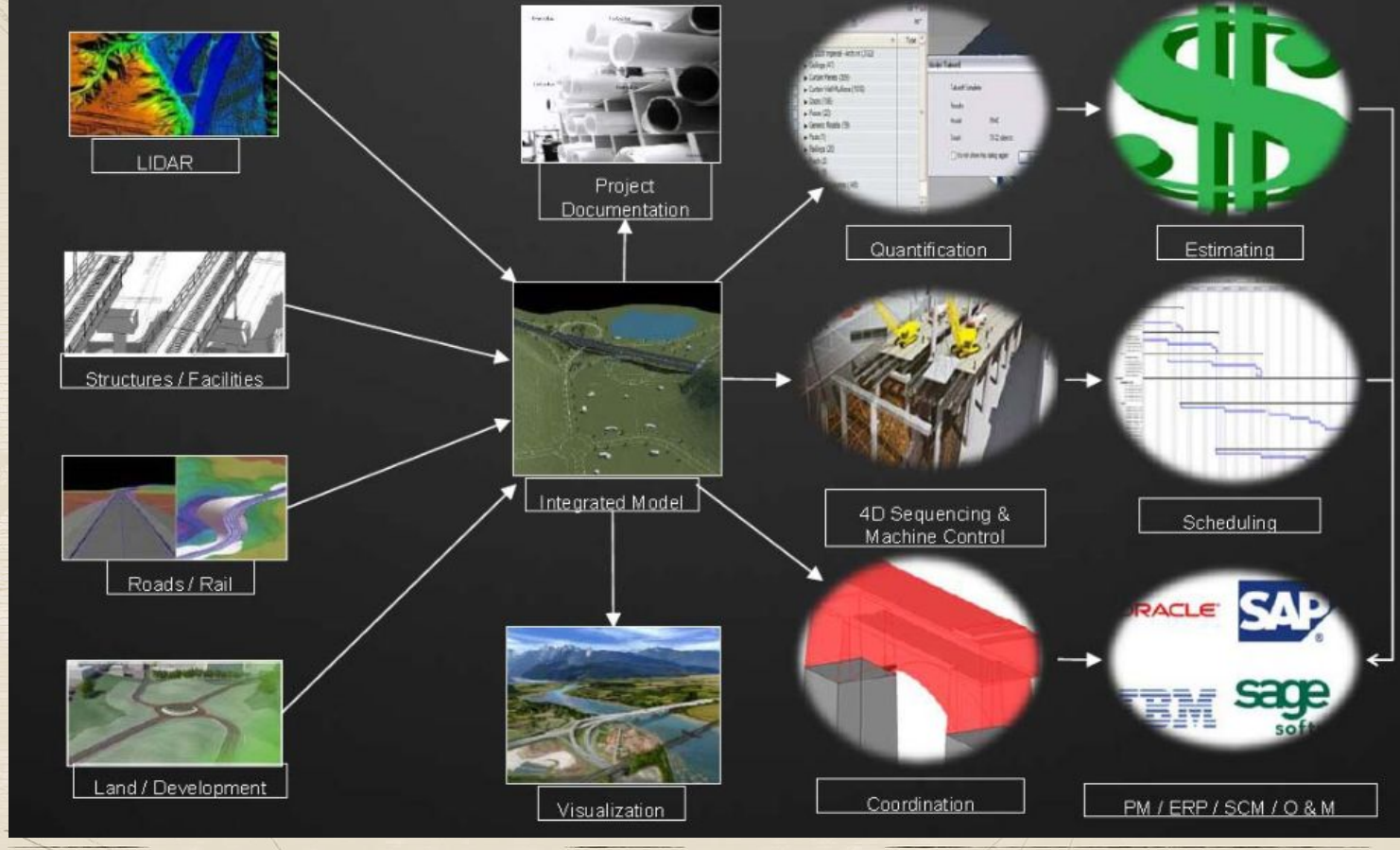
Apps

What is CIM?

"Civil Integrated Management (CIM) is the technology-enabled collection, organization, managed accessibility, and the use of accurate data and information throughout the life cycle of a transportation asset. The concept may be used by all affected parties for a wide range of purposes, including planning, environmental assessment, surveying, construction, maintenance, asset management, and risk assessment." -FHWA, AASHTO, ARTBA (2012)

- **Why use CIM?**
- *CIM can have great benefits in cost and time savings on projects*
- *CIM can improve information flow*
  - *Transparency among project stakeholders*
  - *Improve outreach to the public*
- *CIM can increase the effectiveness of agency professionals and service providers*
  - *Breach traditional silos*
  - *Improve information quality and availability*
  - *Increase productivity*
  - *Improve interfaces with contracted professionals*

Heavy civil construction projects – BIM + geospatial



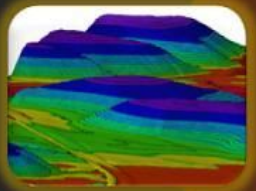
BIM for Sustainable Cities

Planning, Site Selection, Conceptual Design

Surveying and Data Collection

Multidiscipline Coordination

Simulation Analysis



Modeling & Design

Construction Documentation

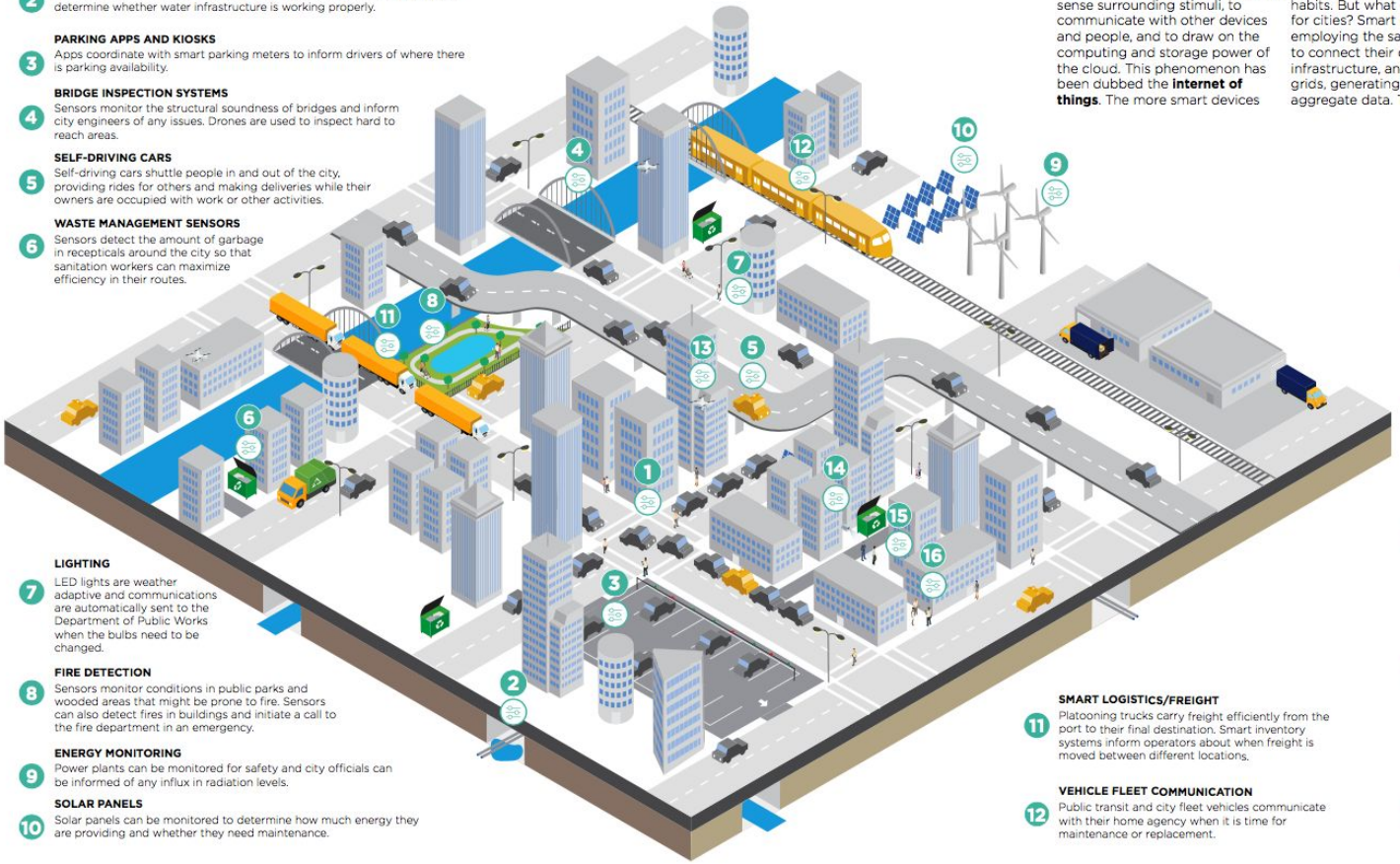
Visualization

Op. & Maint

Construction Management

INTERNET OF THINGS IN CONNECTED CITIES

Every consumer product and piece of infrastructure increasingly has the ability to sense surrounding stimuli, to communicate with other devices and people, and to draw on the computing and storage power of the cloud. This phenomenon has been dubbed the **internet of things**. The more smart devices and sharing platforms there are, the more data is generated about consumer's preferences and habits. But what does this mean for cities? Smart cities are employing the same technology to connect their disparate utility, infrastructure, and public service grids, generating real-time aggregate data. This, in turn, can help cities manage their programs and services more effectively and gauge their impact immediately. The city of the future is an interconnected one, where devices communicate with one another in a constant stream of data that provides real-time information to the public and to the municipality.



1. **TRANSPORTATION CONGESTION SENSORS**
Smart transportation systems use sensors to detect congestion and bottlenecks in traffic patterns. They also rely on cameras to enforce speed and traffic infractions. In doing so, these tools gather real time information that can be used by city DOTs to make mobility networks safer and more efficient.

2. **WATER AND WASTEWATER MONITORING**
Monitoring devices can detect leaks as well as changes in water pressure to determine whether water infrastructure is working properly.

3. **PARKING APPS AND KIOSKS**
Apps coordinate with smart parking meters to inform drivers of where there is parking availability.

4. **BRIDGE INSPECTION SYSTEMS**
Sensors monitor the structural soundness of bridges and inform city engineers of any issues. Drones are used to inspect hard to reach areas.

5. **SELF-DRIVING CARS**
Self-driving cars shuttle people in and out of the city, providing rides for others and making deliveries while their owners are occupied with work or other activities.

6. **WASTE MANAGEMENT SENSORS**
Sensors detect the amount of garbage in recepticals around the city so that sanitation workers can maximize efficiency in their routes.

7. **LIGHTING**
LED lights are weather adaptive and communications are automatically sent to the Department of Public Works when the bulbs need to be changed.

8. **FIRE DETECTION**
Sensors monitor conditions in public parks and wooded areas that might be prone to fire. Sensors can also detect fires in buildings and initiate a call to the fire department in an emergency.

9. **ENERGY MONITORING**
Power plants can be monitored for safety and city officials can be informed of any influx in radiation levels.

10. **SOLAR PANELS**
Solar panels can be monitored to determine how much energy they are providing and whether they need maintenance.

11. **SMART LOGISTICS/FREIGHT**
Platooning trucks carry freight efficiently from the port to their final destination. Smart inventory systems inform operators about when freight is moved between different locations.

12. **VEHICLE FLEET COMMUNICATION**
Public transit and city fleet vehicles communicate with their home agency when it is time for maintenance or replacement.

13. **DRONES**
Drones can be used for law enforcement and firefighting, as rural ambulances, for infrastructure inspections, and for environmental monitoring. Commercial uses include precision farming, aerial photography, and in the near future, package delivery.

14. **SURVEILLANCE CAMERAS**
Cameras ensure security by monitoring activity in areas that are not frequented by public safety officers. Areas that are not open to public access can be monitored to keep unauthorized personnel out.

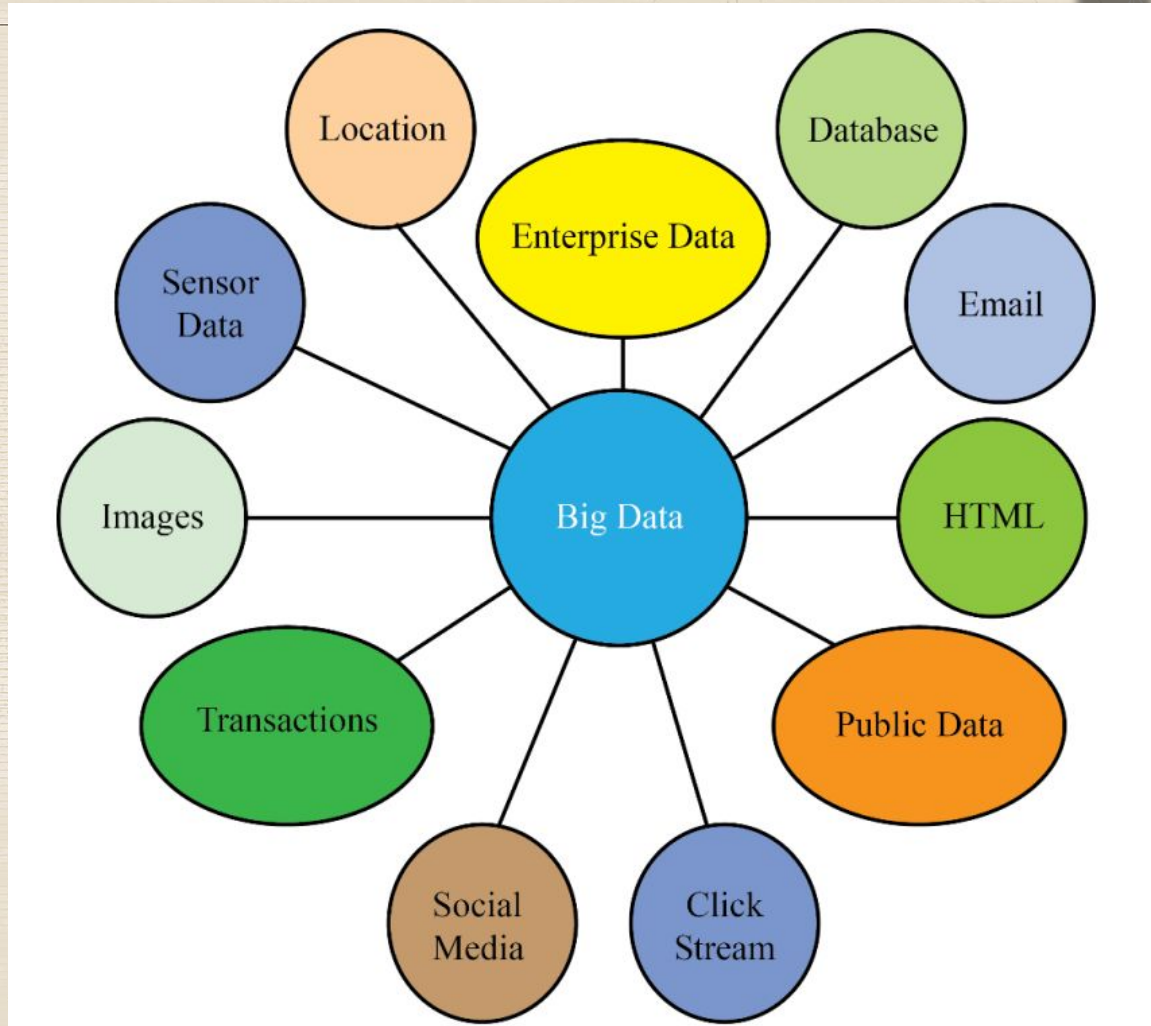
15. **BODY CAMERAS**
Public safety officers can wear body cameras that capture footage of interactions between themselves and city residents to ensure safety for both parties.

16. **WEARABLE DETECTION**
Cities can build in smartphone and wearable detection sensors so that people can be an active part of the internet ecosystem, communicating with the city, and with each other.

17. **BROADBAND INFRASTRUCTURE**
A reliable internet ecosystem is the glue that holds the internet of things together.

Big Data in Smart Cities.

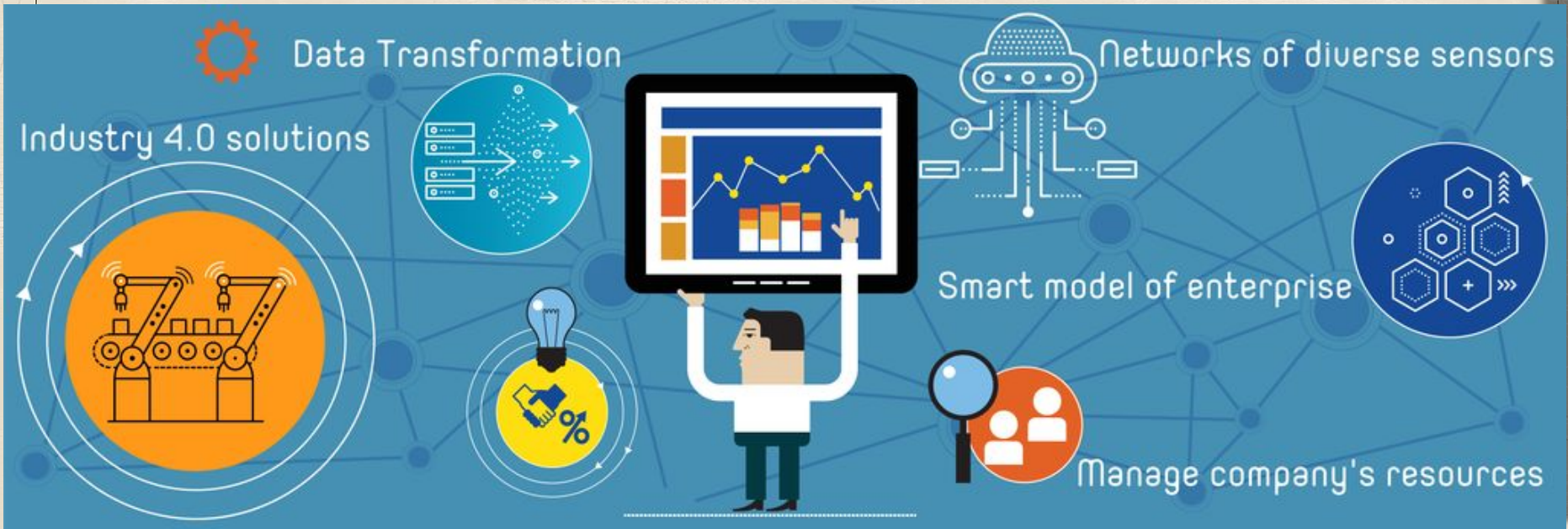
Big Data has several important characteristics including the following:
(1) complexity, (2) volume, (3) variety, (4) variability, (5) veracity



Smart Enterprise Monitor

enterprise Digital Twins driven by AI, Big Data and IoT to assist owners and operators in holistic management and control of complex business processes in manufacturing, services and distribution, condition monitoring to improve performance, efficiency and sustainability

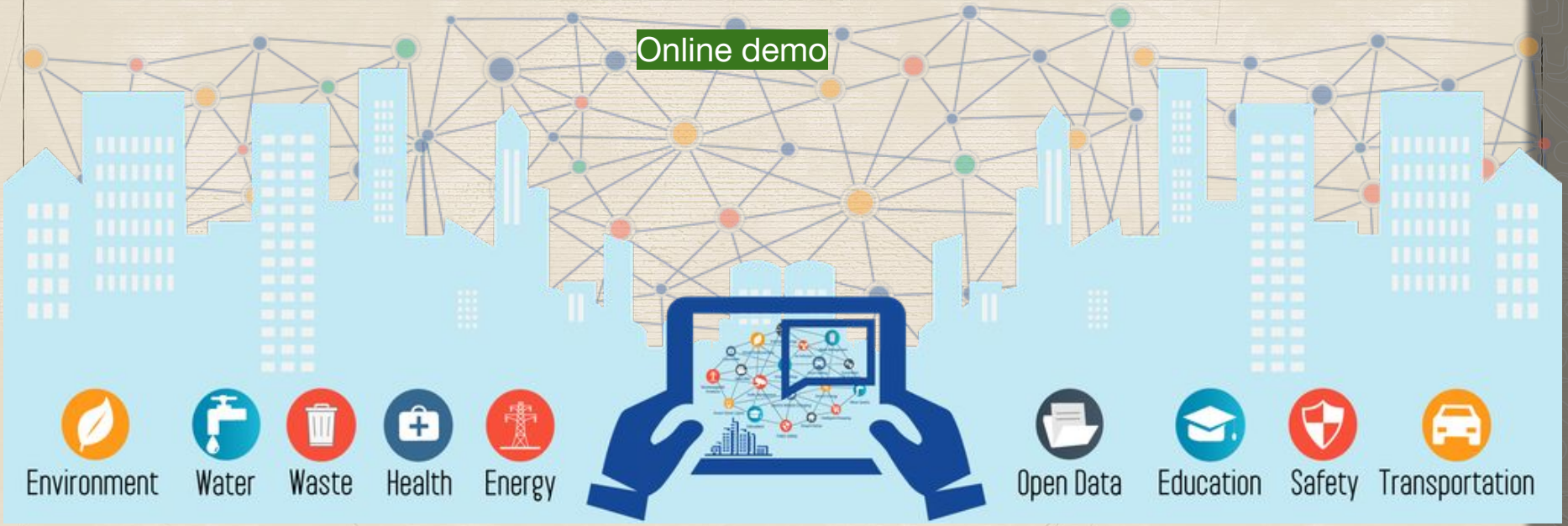
Online demo



Smart City Monitor

powerful Digital Twins for urban areas driven by AI, Big Data and IoT to assist governing bodies, administrations, utility providers and citizens improving quality of life, its sustainability, resource efficiency and transparency of processes and achievements

Online demo



IoT Integrator tools for rapid development of intelligent custom solutions

tools for system integrators to make and run complex tailored IoT, AI and Big Data solutions using big real time data from diverse sensors, automated systems and mobile apps in physical and virtual worlds to provide customers with holistic monitoring and analytics

Online demo

66 °F
Outdoor Temperature

62.7% rH
Outdoor Humidity

21.2 mm
Rainfall

Changi Campus Dashboard

Changi Campus

9

Critical Alarm Summary

Whitespace	9	Fire	
Building		Mechanical	
Electrical		Security	

7
Number of Data Centers

80
Number of Customers

$ 176K
▲ 3%
Electricity Utility

$ 168K
▼ 8%
Water Utility

$ 178K
▲ 7%
Natrual Gas Utility

Average PUE

Average vs Target

Electrical Usage
1,137 kWh

Current Use vs Capacity

Power Utilization

Current Use vs Capacity

Cooling Utilization

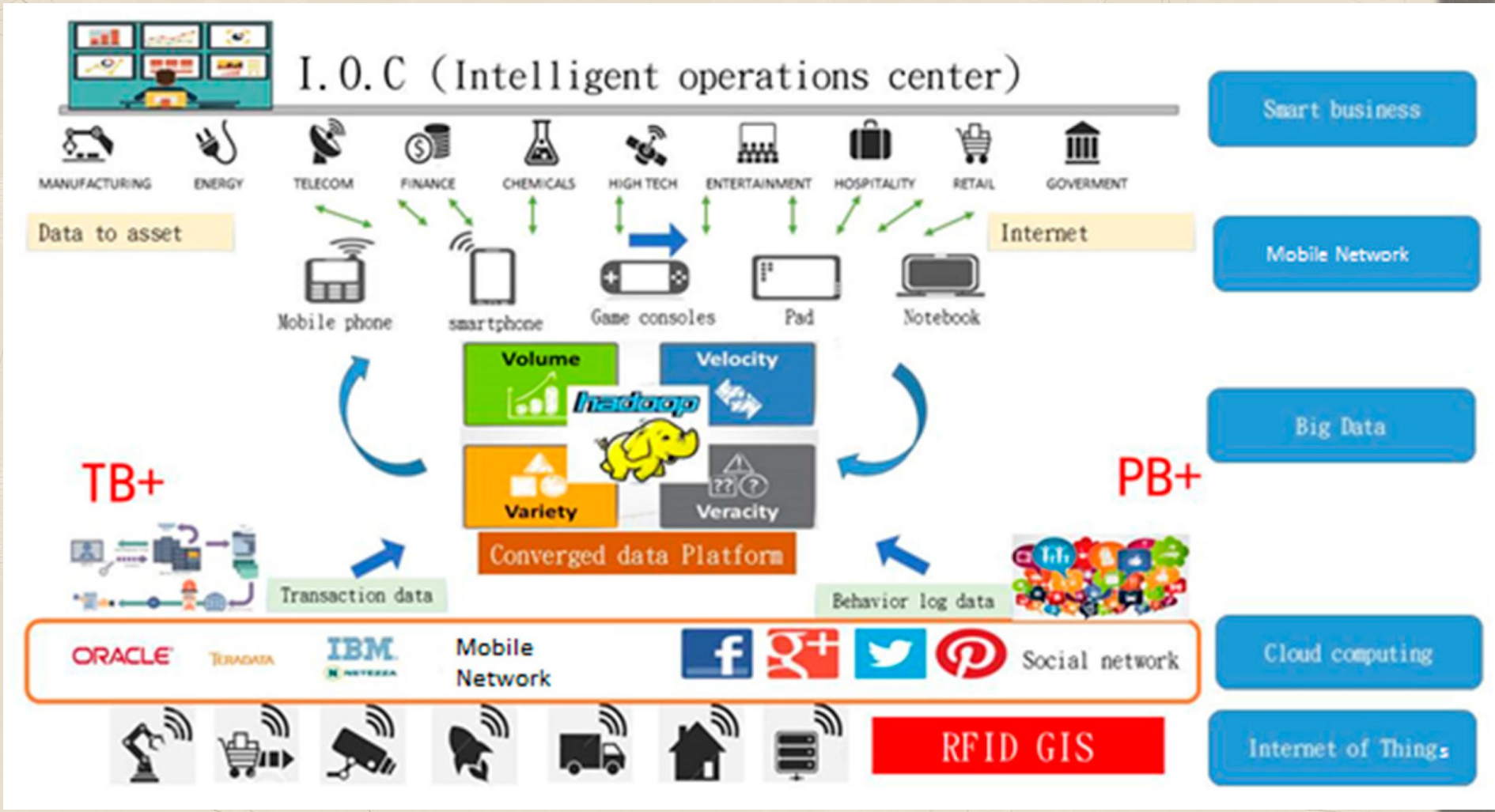
Current Use vs Capacity

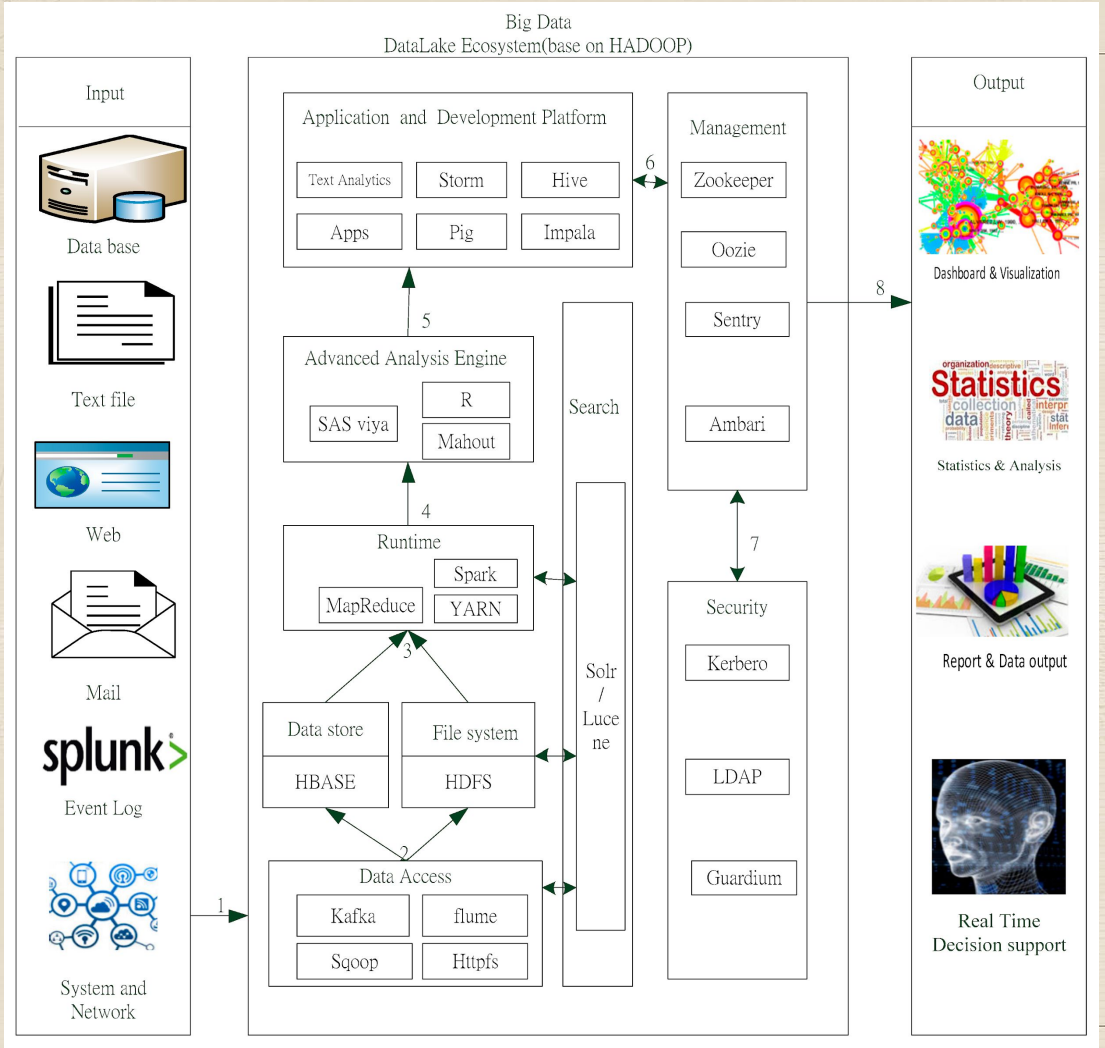
Rack Utilization

Current Use vs Capacity

Network Utilization

Current Use vs Capacity


I.O.C (Intelligent operations center)
MANUFACTURING
ENERGY
TELECOM
FINANCE
CHEMICALS
HIGH TECH
ENTERTAINMENT
HOSPITALITY
RETAIL
GOVERMENT
Data to asset
Internet
Mobile phone
smartphone
Game consoles
Pad
Notebook
Volume
Velocity
hadoop
Variety
Veracity
Converged data Platform
TB+
PB+
Transaction data
Behavior log data
ORACLE
TERADATA
IBM
NETEZZA
Mobile Network
Social network
RFID GIS
Smart business
Mobile Network
Big Data
Cloud computing
Internet of Things


Big Data
DataLake Ecosystem(base on HADOOP)
Input
Data base
Text file
Web
Mail
splunk>
Event Log
System and Network
Application and Development Platform
Text Analytics
Storm
Hive
Apps
Pig
Impala
Management
Zookeeper
Oozie
Sentry
Ambari
Advanced Analysis Engine
SAS viya
R
Mahout
Search
Runtime
Spark
MapReduce
YARN
Solr / Lucene
Data store
HBASE
File system
HDFS
Data Access
Kafka
flume
Sqoop
Httpfs
Security
Kerbero
LDAP
Guardium
1
2
3
4
5
6
7
8
Output
Dashboard & Visualization
Statistics & Analysis
Report & Data output
Real Time
Decision support

Elected Officials | Municipal Employees | Public

Application Layer

Health | Intelligent buildings | Intelligent transportation | Open data

Public safety and security | Environmental Protection | Urban planning

Emergency Services | Utilities | Sanitation | Education

Business Layer

Analytics and Models | Visualization and Decision Support | Catalogs, Semantics | Metadata

Data Layer

Data Access

Urban/Municipal Database

Other Data | Enterprise Data | Economic Data | Population Data | Geospatial Data

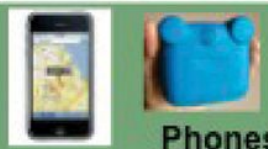
Data Ingest and Quality Checking

Sensing Layer

City Sensor Webs

Sensor networks

Crowdsourcing



Phones, Wearables

Cloud hosted resources

Security System

Open Street Map

- Geo-data is not free
- In most countries you must pay the national mapping agency to license the data
- To buy the entire Ordnance Survey National database of the UK would cost £50 Million (€73 Million)
- "The OpenStreetMap Foundation is an international non-profit organisation dedicated to encouraging the growth, development and distribution of free geospatial data and to providing geospatial data for anybody to use and share."

https://kartaview.org/map/@25.326309513187 24,51.145819780942475,9z

What is OSM?

- Not software
- One world-wide geographic database with many contributors – “GeoWiki”
- Phocus on streets – but also other features like land cover and POI
- Geometry types: Nodes, ways and closed ways (“areas”)
  Relations – group of geometries (Data Primitives)
- GPS-measured – quite good accuracy but not so detailed
  Stored in latitude/longitude – rendered in spherical Mercator projection
- Map Features with defined tags (common and extensible object model)
- Profiles like OpenCycleMap (specific tags and rendering)
- Open Geo Data
- There are many “free” basemaps, Google, Yahoo, Bing...
- These only give limited rights of use
- OSM gives users rights to any kind of reproduction or processing
- Creative Commons license

Methodology

People, like you and me, gather location data across the globe from a variety of sources such as:

- Recordings from GPS devices
- Public domain data
- Digitizing against free satellite imagery

This information then gets uploaded to OpenStreetMap's central database from where it can be further modified, corrected and enriched by anyone who notices missing facts or errors about the area.

Who owns OSM data?

Collaboration – the contributors are the owners, with the Creative Commons Attribution/ShareAlike license (CC-BY-SA 2.0)

- Anyone can copy OSM data
- But if you incorporate it into something else, that “something else” also has to be copiable under the same terms and conditions (ShareAlike)
- When you copy it, you have to give credit to the copyright owner (Attribution)

Supporting, not controlling:
OpenStreetMap Foundation, www.osmfoundation.org

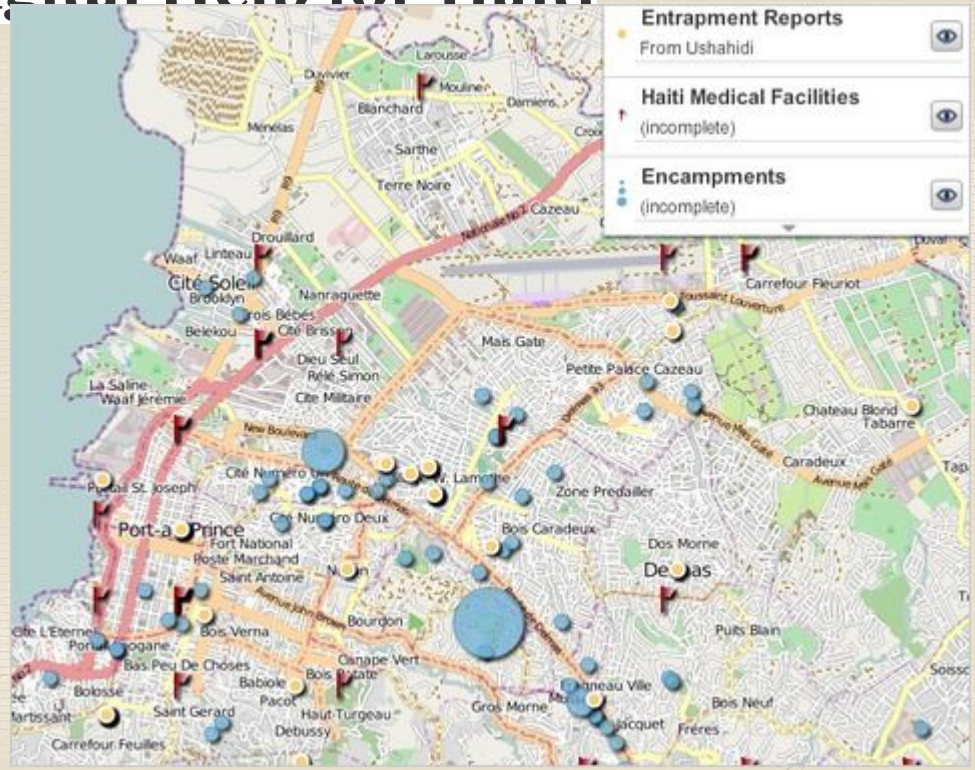
Why?

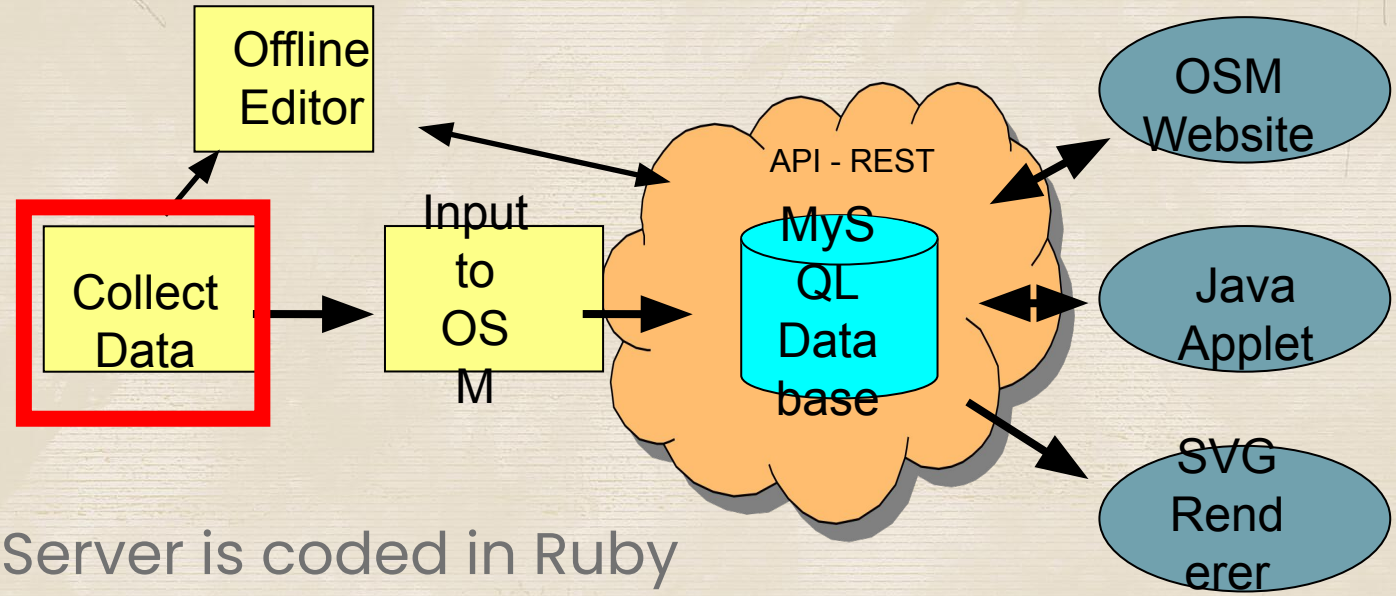
Geodata is expensive, difficult to order and to use
Especially true for vector data (and orienteering map data …)
Object models are not standardized (ISOM is a notable exception)
“Free” alternatives (e.g. Google Maps) are proprietary

How?

- Database – PostgreSQL (earlier MySQL)
- Editors – Potlatch (Flash), JOSM (Java), Merkaator (Qt, i.e. C++)
  Interactive editing (GPS tracks) and batch import
- Renderer – Mapnik (out: raster tiles) and Osmarender (out: SVG)
- Runs on Linux, Mac and Windows
- OpenSource – all software (except maybe OS)

Digital Help for Haiti





- Server is coded in Ruby
- The entire site is currently being transferred to Rails

Getting the data - the OSM way

Step 1 - Collect data using a GPS receiver

- We cannot use copyrighted maps to get street name information. So...

Getting the data - the OSM way

Step 2 - Convert to GPX format (we recommend GPSBabel)

```
<?xml version="1.0"?>
<gpx
 version="1.0"
creator="GPSBabel - http://www.gpsbabel.org"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://www.topografix.com/GPX/1/0"
xsi:schemaLocation="http://www.topografix.com/GPX/1/0 http://www.topografix.com/GPX/1/0/gpx.xsd
```

OSM XML - http://wiki.openstreetmap.org/wiki/OSM_XML

```
<osm version="0.6" generator="Osmosis SNAPSHOT-r26543">
  <bound box="34.01978,-117.22435,34.08958,-117.13878" origin="Osmosis SNAPSHOT-r2654
  <node id="1487933542" version="1" timestamp="2011-10-31T22:52:01Z" uid="409545" user="
-117.1977484">
    <tag k="name" v="180 Chiropractic"/>
    <tag k="amenity" v="doctors"/>
  </node>
  ...
  <way id="13884[illegible]" version="1" timestamp="2011-11-29T00:20:18Z" uid="304970" user="
    <nd ref="15224[illegible]"/>
    <nd ref="1522479499"/>
    <nd ref="1522479502"/>
    <nd ref="1522479504"/>
    <nd ref="1522479496"/>
    <tag k="building" v="yes"/>
  </way>
  ...
  <relation id="[illegible]" version="2" timestamp="2012-09-11T23:31:01Z" uid="194231" user="xx" changeset="13076706">
    <member type="way" ref="17243[illegible]" role="forward"/>
    <member type="way" ref="29001116" role="forward"/>
    ...
    <tag k="ref" v="10"/>
    <tag k="symbol" v="http://upload.wikimedia.org/wikipedia/commons/c/c3/I-10_%28CA%29.svg"/>
    <tag k="direction" v="west"/>
    <tag k="route" v="road"/>
    <tag k="name" v="I 10 (CA westbound)"/>
    <tag k="is_in:state" v="CA"/>
    <tag k="wikipedia" v="en:Interstate 10 in California"/>
    <tag k="type" v="route"/>
    <tag k="network" v="US:I"/>
  </relation>
```

version of the API (the features used) and the generator that distilled this file

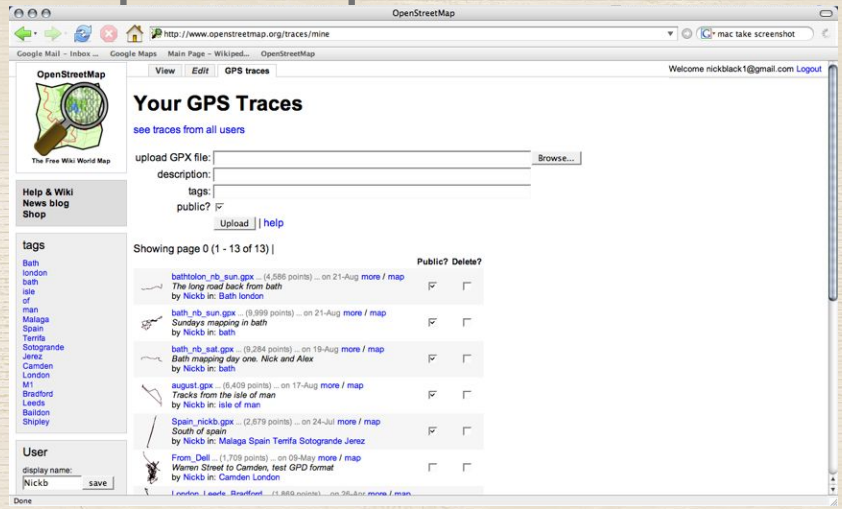
Node: location, and tags

Way: references to its nodes for each way, and tags

Relation: references to its members for each relation, and tags

Getting the data - the OSM way

Step 3 - Upload to OSM

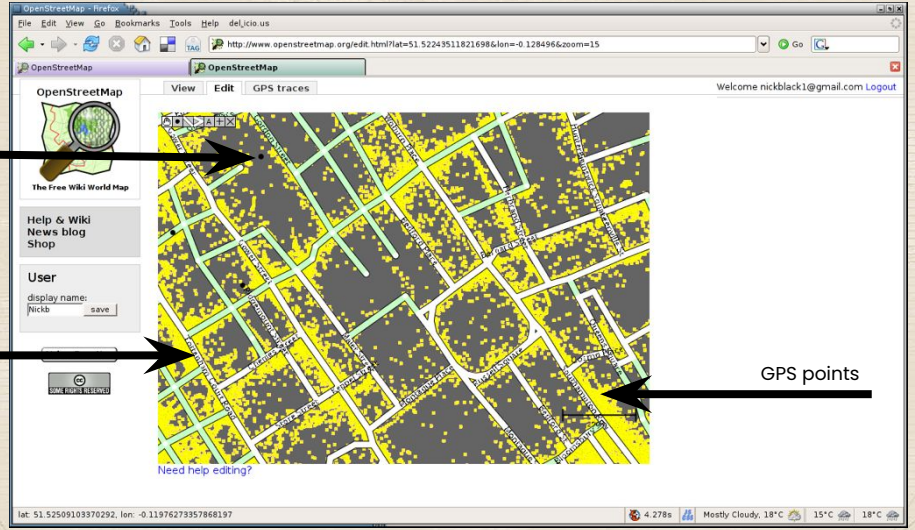


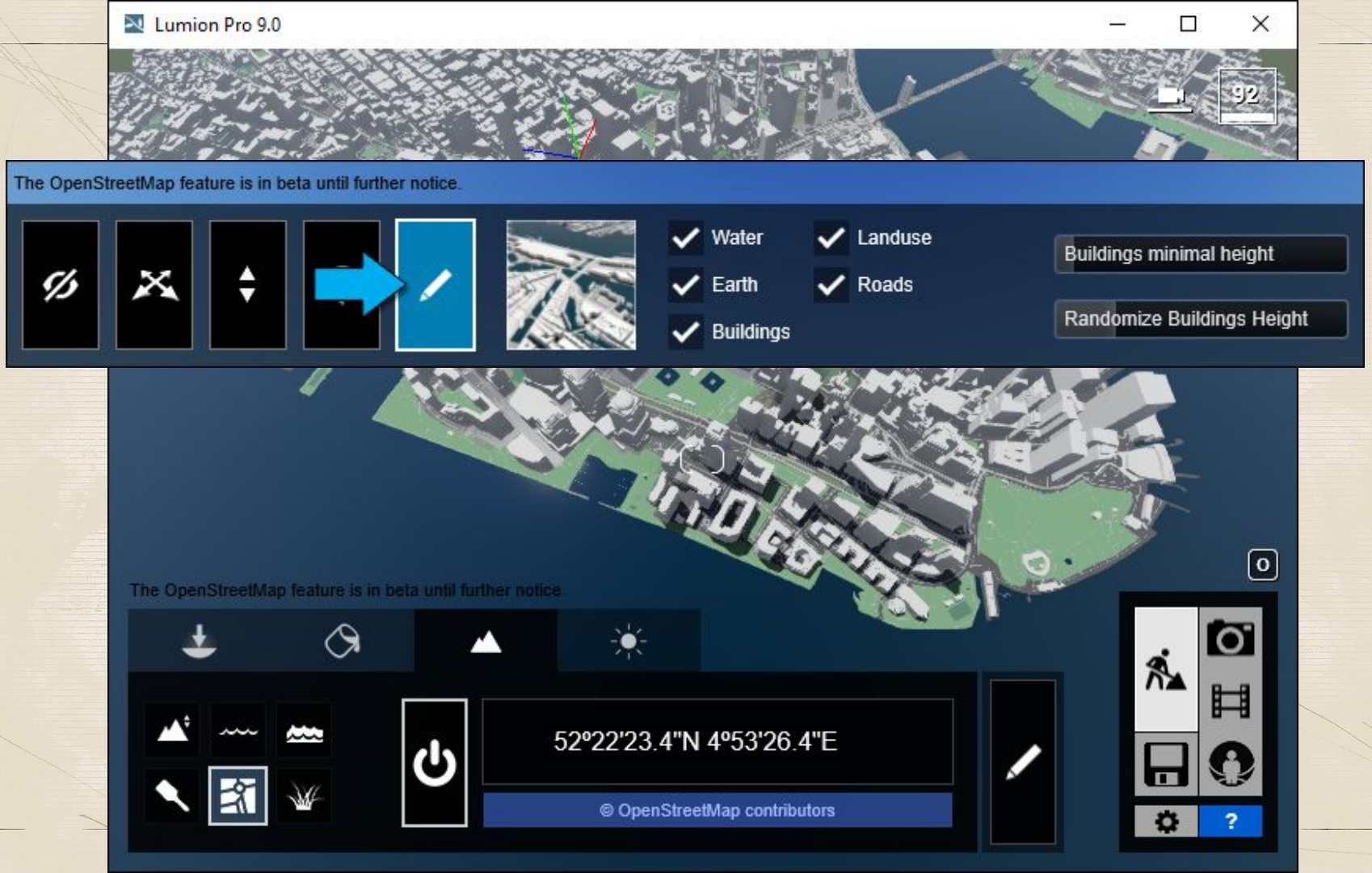
- Data is instantly available via the web portal or the API

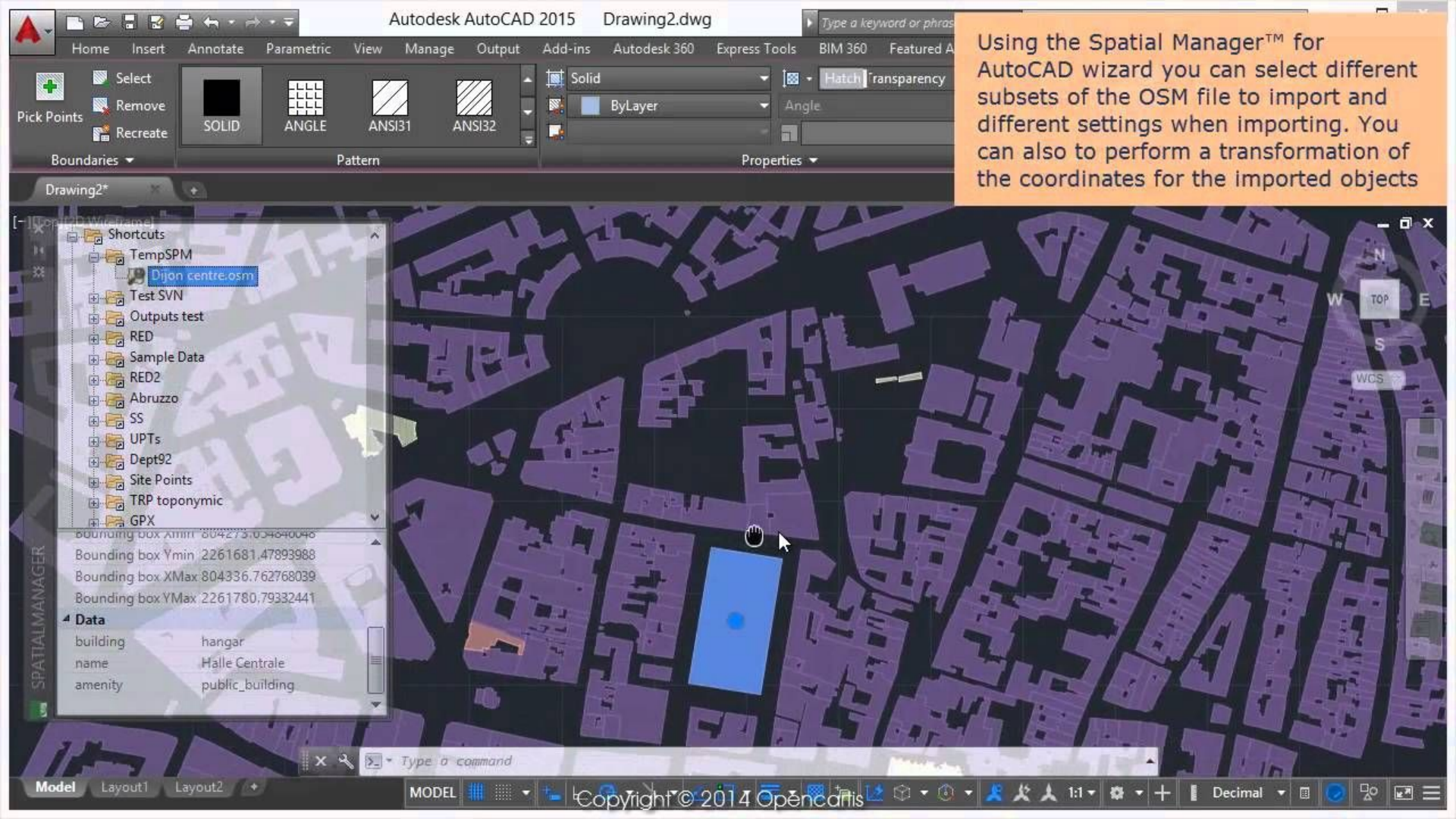
Getting the data - the OSM way

Step 4 - Edit the data

- Java applet allows basic editing: creating, naming and deletion of ways and segments




Lumion Pro 9.0
92
The OpenStreetMap feature is in beta until further notice.
Water
Landuse
Earth
Roads
Buildings
Buildings minimal height
Randomize Buildings Height
The OpenStreetMap feature is in beta until further notice
52°22'23.4"N 4°53'26.4"E
© OpenStreetMap contributors
?

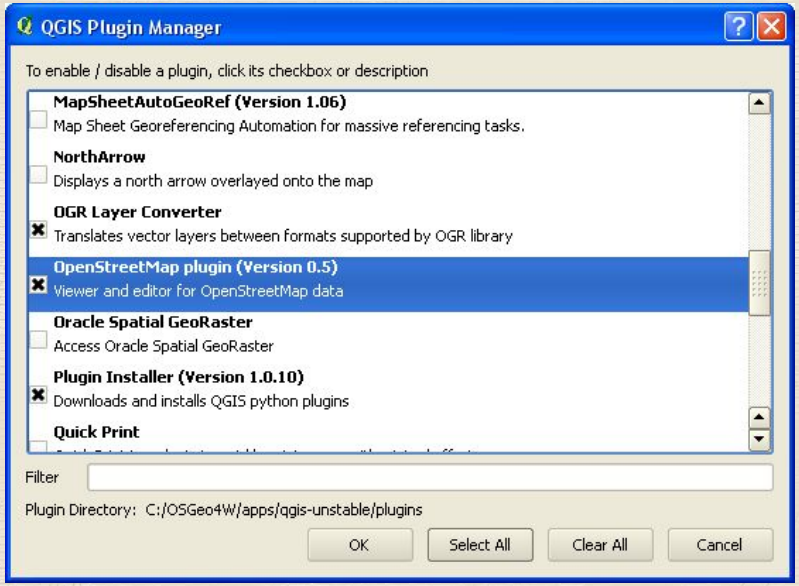


Using the Spatial Manager™ for AutoCAD wizard you can select different subsets of the OSM file to import and different settings when importing. You can also to perform a transformation of the coordinates for the imported objects

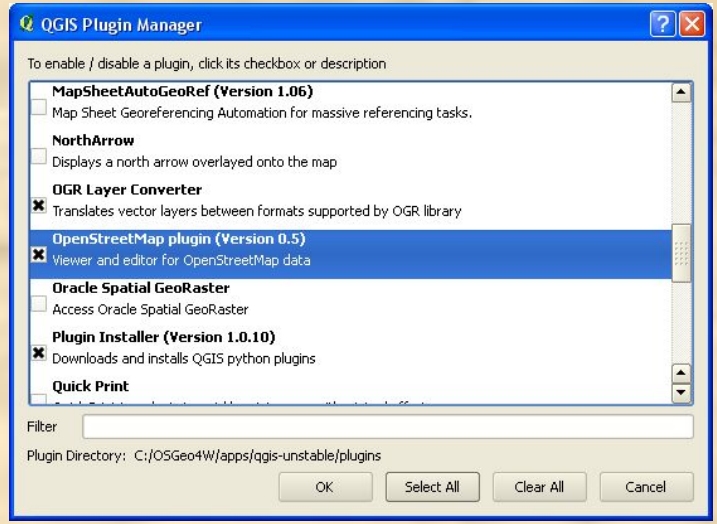
Copyright © 2014 Opencartis

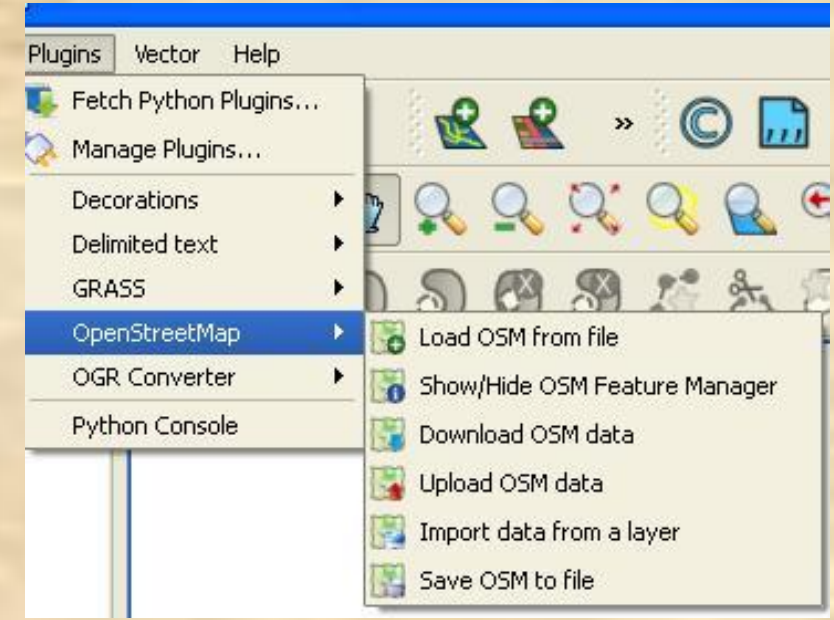
CyberCity 3D buildings in London compared to OSM models (as seen in Autodesk InfraWorks 360)

QGIS OSM Plug In

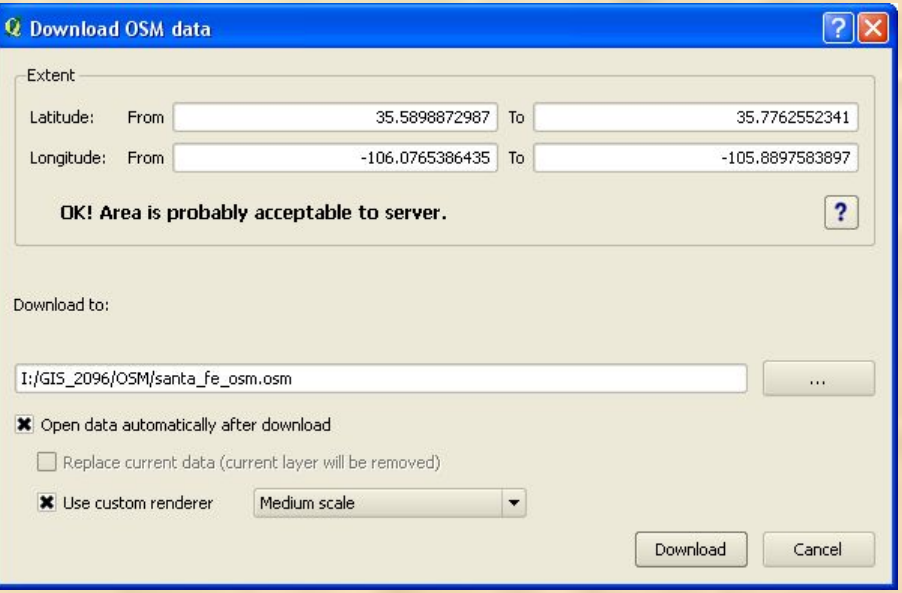

QGIS Plugin Manager
To enable / disable a plugin, click its checkbox or description
MapSheetAutoGeoRef (Version 1.06)
Map Sheet Georeferencing Automation for massive referencing tasks.
NorthArrow
Displays a north arrow overlayed onto the map
OGR Layer Converter
Translates vector layers between formats supported by OGR library
OpenStreetMap plugin (Version 0.5)
Viewer and editor for OpenStreetMap data
Oracle Spatial GeoRaster
Access Oracle Spatial GeoRaster
Plugin Installer (Version 1.0.10)
Downloads and installs QGIS python plugins
Quick Print
Filter
Plugin Directory: C:/OSGeo4W/apps/qgis-unstable/plugins
OK
Select All
Clear All
Cancel

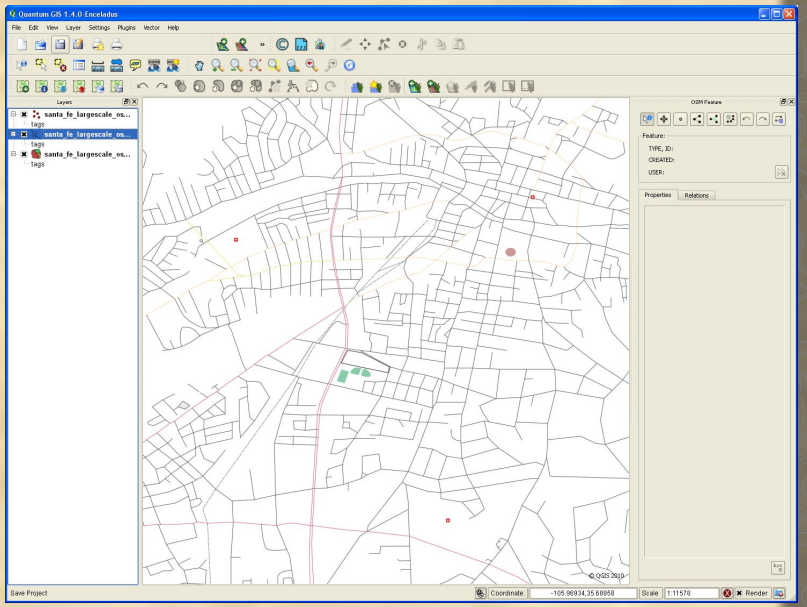
QGIS OSM Plug In


QGIS Plugin Manager
To enable / disable a plugin, click its checkbox or description
MapSheetAutoGeoRef (Version 1.06)
Map Sheet Georeferencing Automation for massive referencing tasks.
NorthArrow
Displays a north arrow overlayed onto the map
OGR Layer Converter
Translates vector layers between formats supported by OGR library
OpenStreetMap plugin (Version 0.5)
Viewer and editor for OpenStreetMap data
Oracle Spatial GeoRaster
Access Oracle Spatial GeoRaster
Plugin Installer (Version 1.0.10)
Downloads and installs QGIS python plugins
Quick Print
Filter
Plugin Directory: C:/OSGeo4W/apps/qgis-unstable/plugins
OK
Select All
Clear All
Cancel

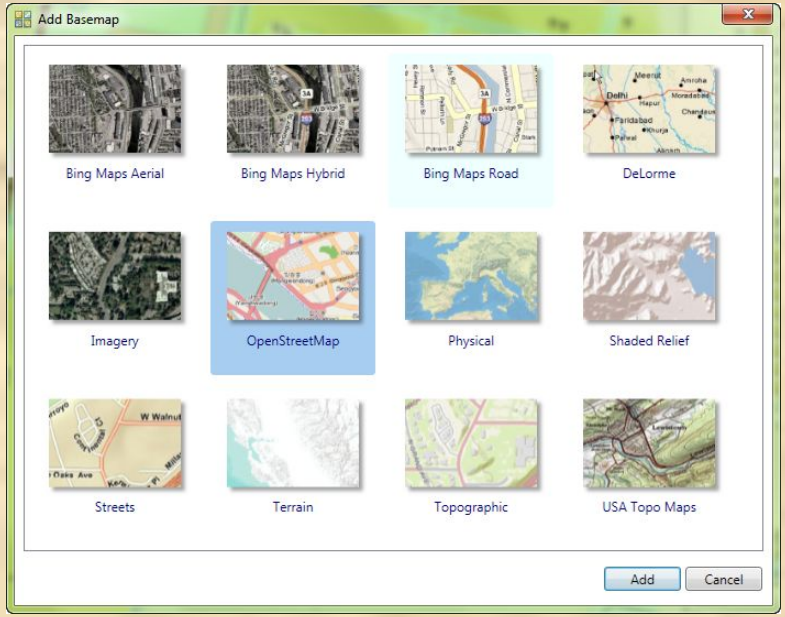


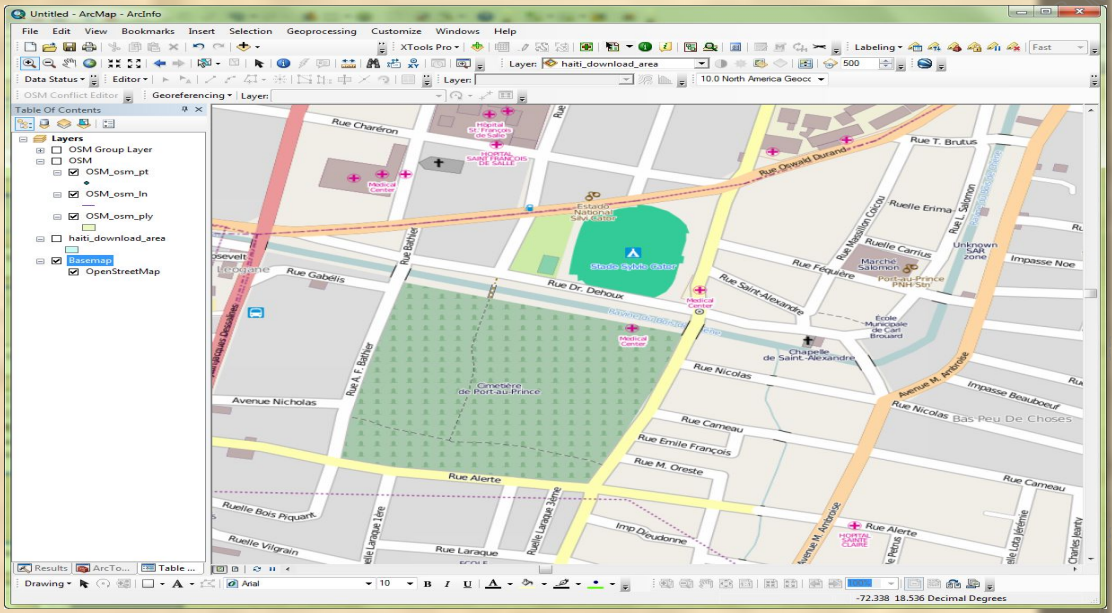
QGIS PlugIn


Download OSM data
Extent
Latitude: From 35.5898872987 To 35.7762552341
Longitude: From -106.0765386435 To -105.8897583897
OK! Area is probably acceptable to server.
Download to:
I:/GIS_2096/OSM/santa_fe_osm.osm
...
Open data automatically after download
Replace current data (current layer will be removed)
Use custom renderer
Medium scale
Download
Cancel

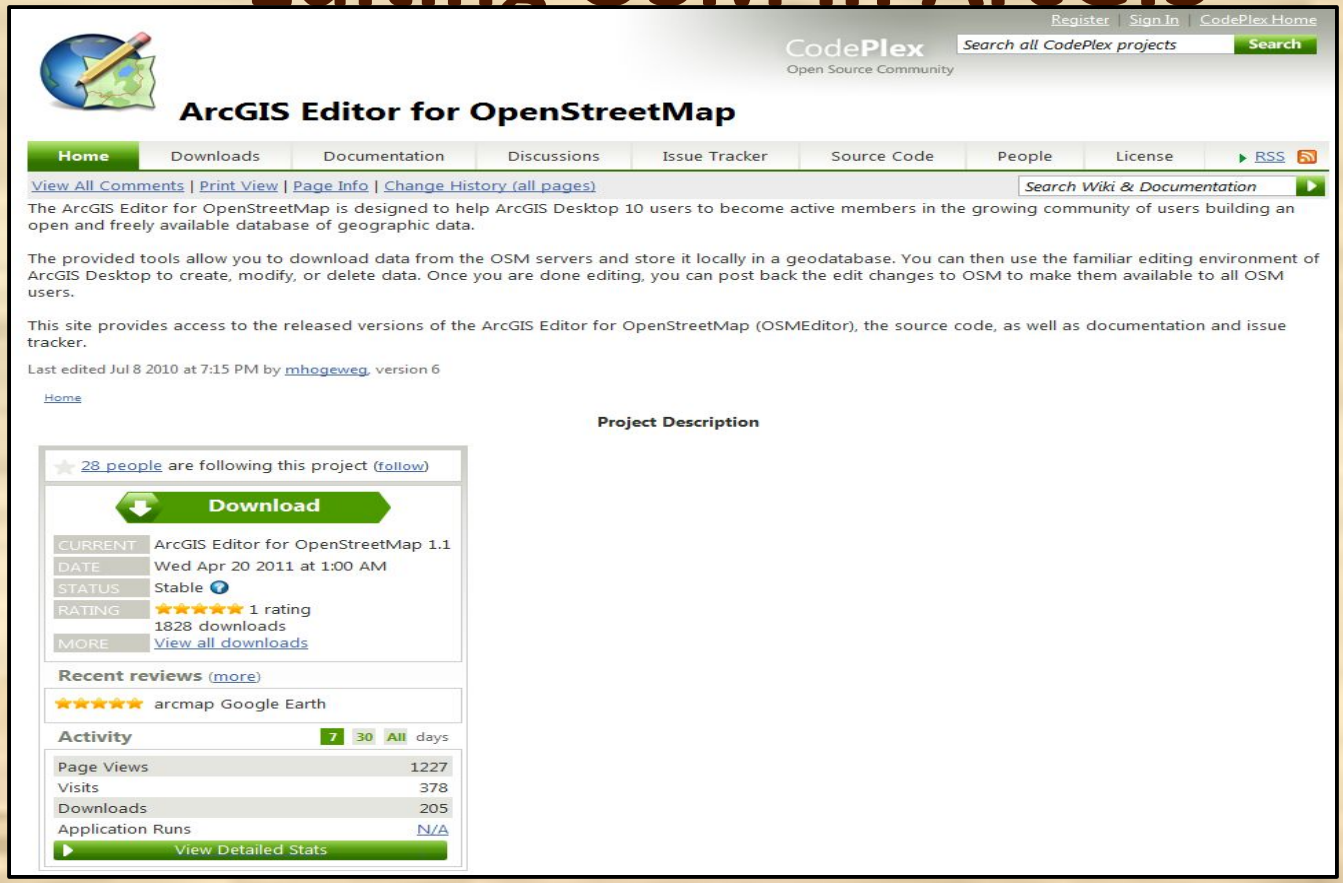


OSM in ArcGIS

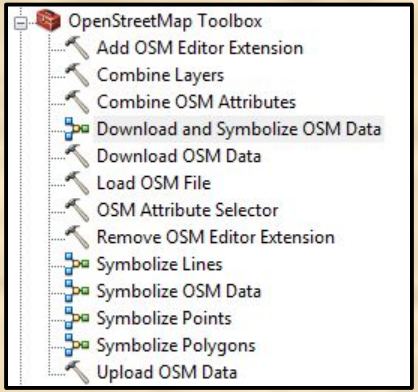


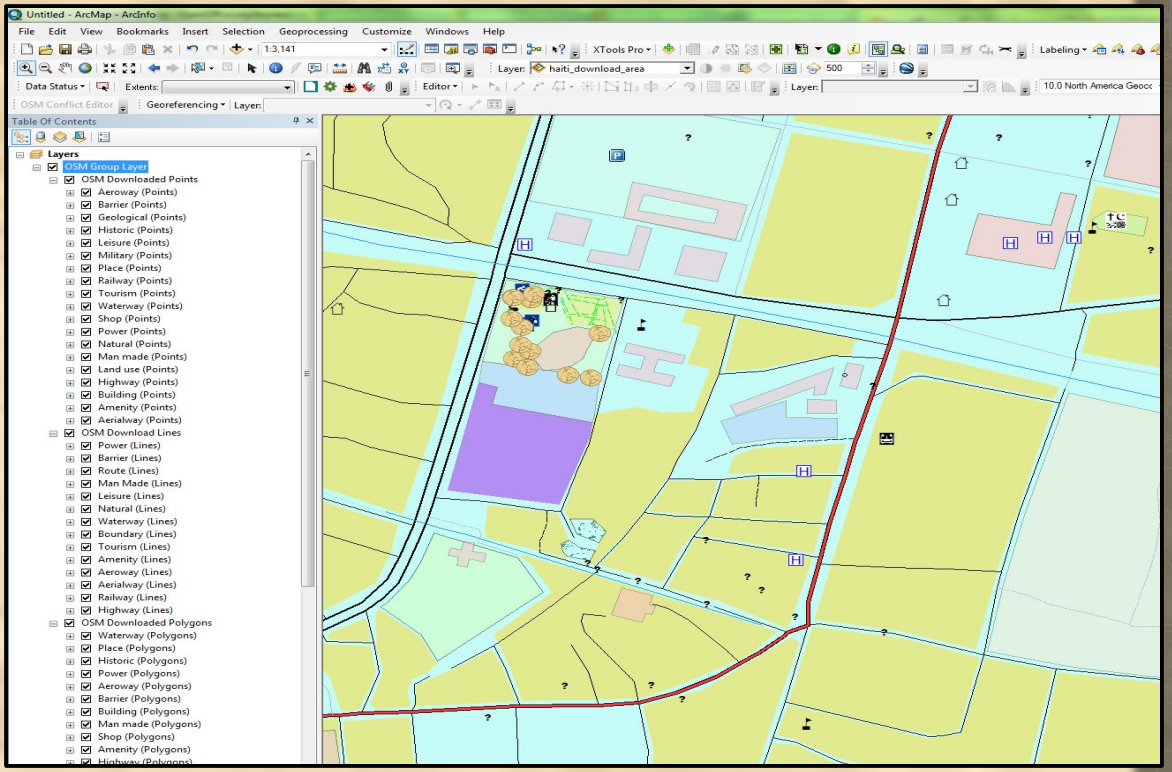


Editing OSM in ArcGIS


Register | Sign In | CodePlex Home
CodePlex
Open Source Community
Search all CodePlex projects
Search
ArcGIS Editor for OpenStreetMap
Home
Downloads
Documentation
Discussions
Issue Tracker
Source Code
People
License
RSS
View All Comments | Print View | Page Info | Change History (all pages)
Search Wiki & Documentation
The ArcGIS Editor for OpenStreetMap is designed to help ArcGIS Desktop 10 users to become active members in the growing community of users building an open and freely available database of geographic data.
The provided tools allow you to download data from the OSM servers and store it locally in a geodatabase. You can then use the familiar editing environment of ArcGIS Desktop to create, modify, or delete data. Once you are done editing, you can post back the edit changes to OSM to make them available to all OSM users.
This site provides access to the released versions of the ArcGIS Editor for OpenStreetMap (OSMEditor), the source code, as well as documentation and issue tracker.
Last edited Jul 8 2010 at 7:15 PM by mhogeweg, version 6
Home
Project Description
28 people are following this project (follow)
Download
CURRENT ArcGIS Editor for OpenStreetMap 1.1
DATE Wed Apr 20 2011 at 1:00 AM
STATUS Stable
RATING 1 rating
1828 downloads
MORE View all downloads
Recent reviews (more)
arcmap Google Earth
Activity 7 30 All days
Page Views 1227
Visits 378
Downloads 205
Application Runs N/A
View Detailed Stats

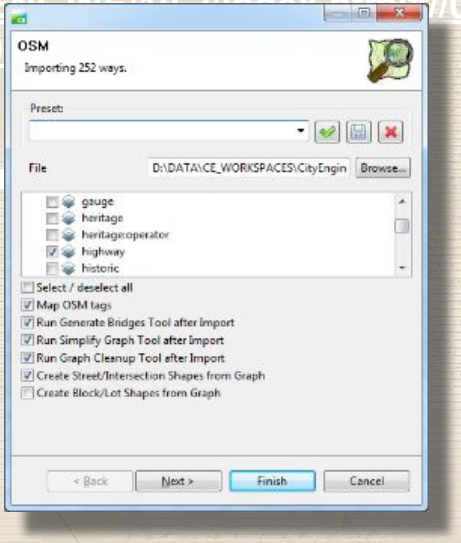
Download OSM in ArcGIS

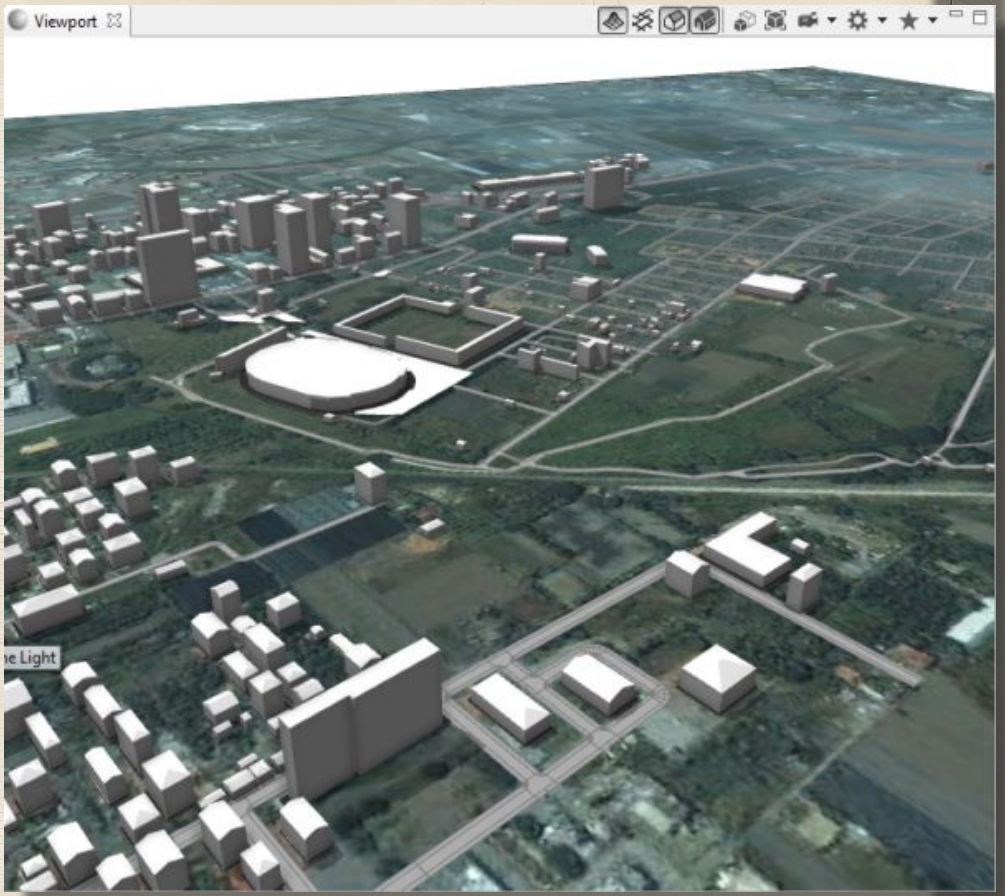




Data to access

- City Engine (see http://resources.arcgis.com/EN/HELP/CITYENGINE/10.2/index.html#//02w10000000)
- Produ



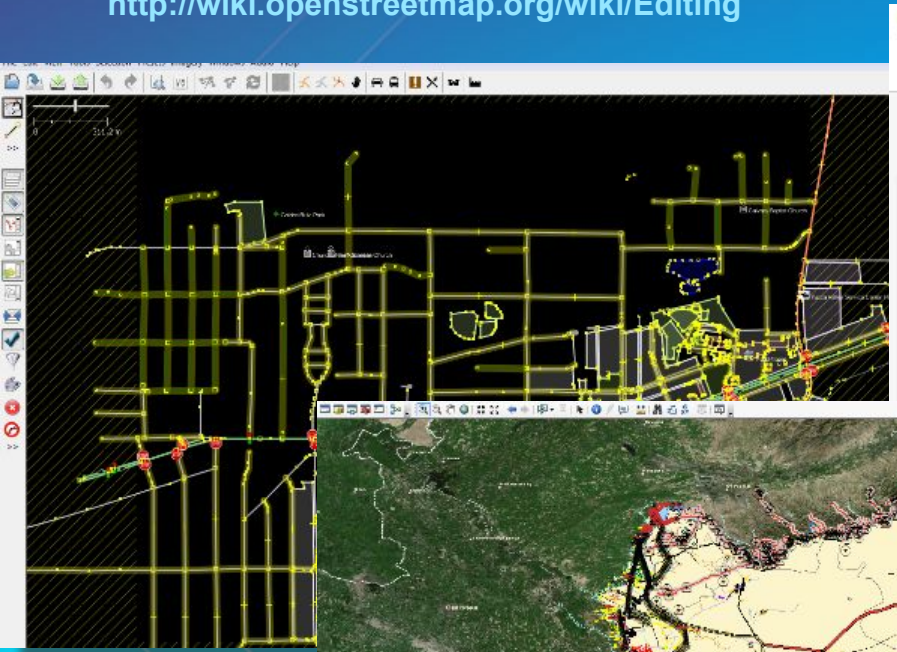


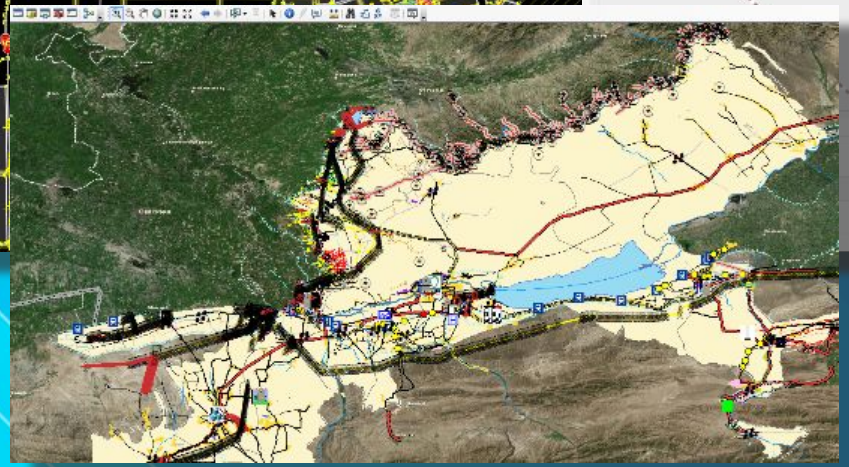
Contributions welcome

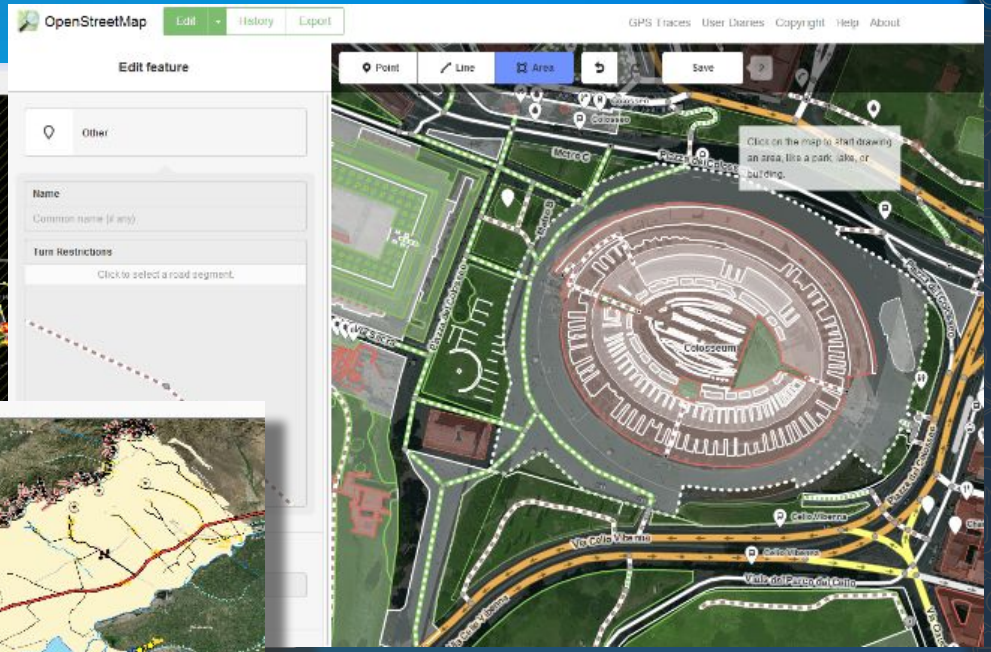
https://wiki.openstreetmap.org/wiki/Mapping_projects

Many tools to contribute data to OSM

http://wiki.openstreetmap.org/wiki/Editing







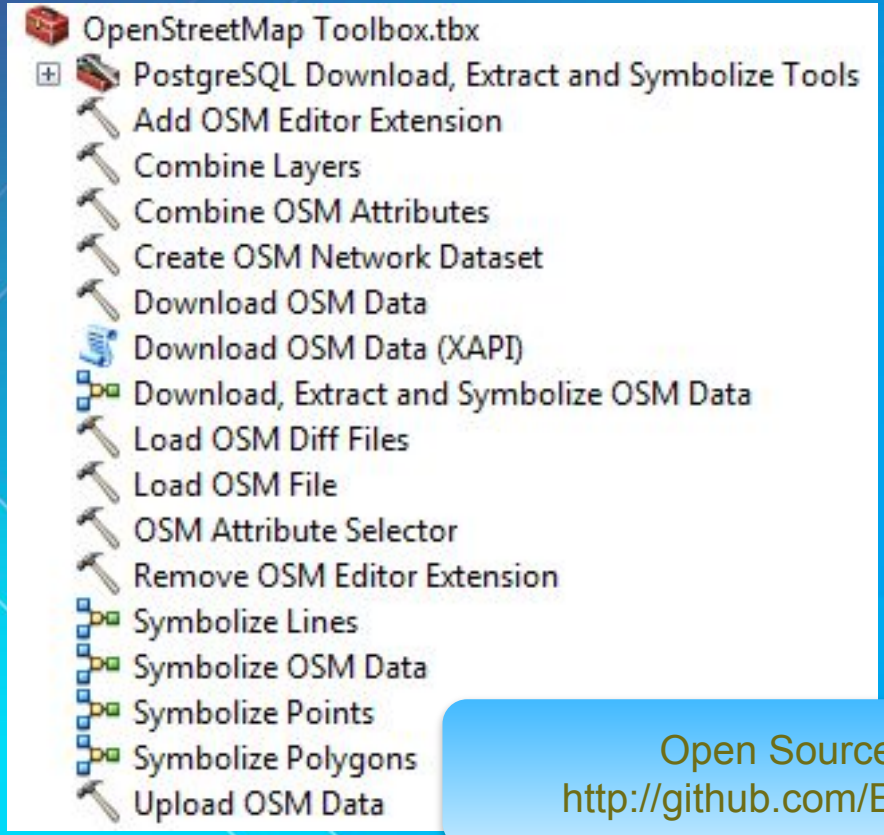
ArcGIS Editor for OpenStreetMap

Download free from ArcGIS Online

ArcGIS Editor for OSM, 10.3.x Desktop
ArcGIS for Desktop tools that support using OpenStreetMap data in ArcGIS. Load .osm files, apply symbology, contribute data back to OSM, and create network datasets from OSM data.
Geoprocessing Sample by ceggers
Last Modified: April 3, 2015
(0 ratings, 3,508 downloads)
Sign in to rate this item.
Facebook
Twitter
OPEN

- **10.3.x and 10.2.2 update: https://github.com/Esri/arcgis-osm-editor/wiki/Release-Notes**

What does ArcGIS Editor for OSM do?



- Translate OSM data into a feature dataset you can use in ArcGIS
- Make a Network Dataset from OSM data
- Support users to contribute data to OSM through ArcMap Editing workflows

Open Source and on github:
http://github.com/Esri/arcgis-osm-editor

ArcGIS Editor for OSM Architecture

OpenStreetMap XML

ArcGIS Editor for OSM

Tools, models, scripts to translate OSM XML to file GDB

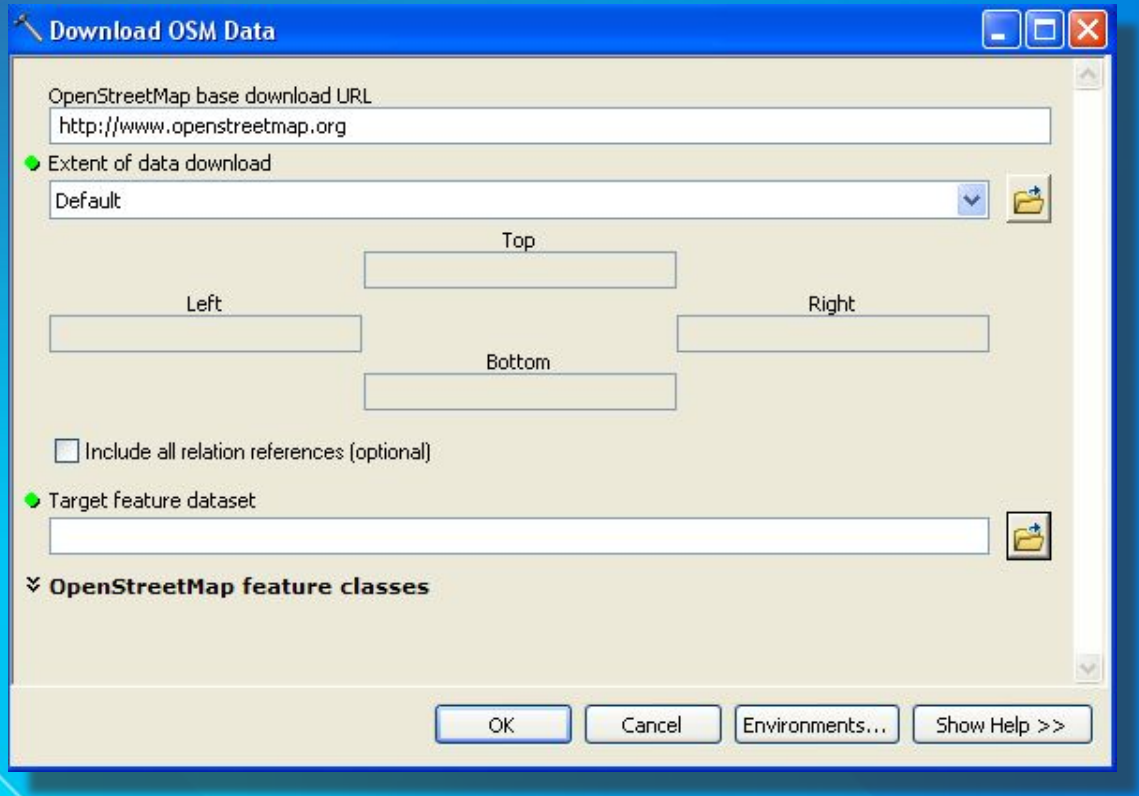
ArcGIS for Desktop

Desktop Web Device

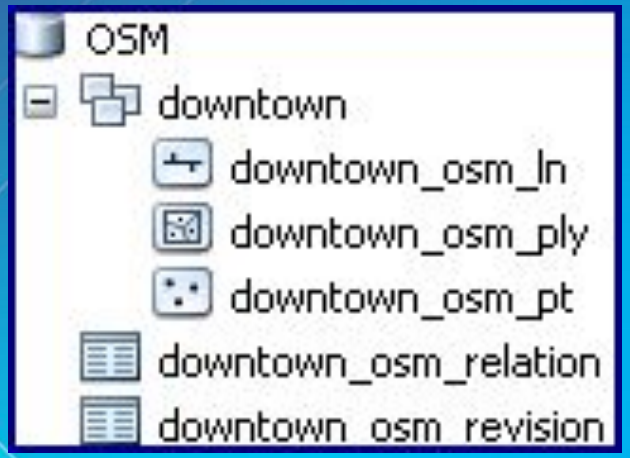
Server

Online Content and Services

Download OSM Data tool



Resulting feature classes and tables



- **osm_relation**
  - Maintains relations between features as described in OSM as the user works with the OSM data in ArcGIS
  - E.g., primary, secondary, and residential types of road line features may have a relation to describe how these define a bus route

- **osm_revision**
  - Track edits to the downloaded OSM dataset that are made by you as you edit it
  - Used if you choose to upload data back to OSM

Editing using the ArcGIS OSM Editor

Demo

Contributing an existing dataset to OSM through ArcGIS

Check with community on data you will contribute
Download an area from OSM
Investigate field mappings and add missing fields to the target
Append the Source to the Target
Make further data edits to the target feature class (optional)
Upload OSM Data

Lots of creative tools and products out there

Want to find out more?

- www.openstreetmap.org
- www.opengeodata.org
- OpenGeoData http://opengeodata.org/
- OSM Streetview
- Open Aerial Map
- Free Earth Foundation
- NASA World Wind
- http://www.freeearthfoundation.com/ (NASA World Wind)
- Open knowledge Foundation http://www.okfn.org/
- The Map http://www.openstreetmap.org/
- Wiki http://wiki.openstreetmap.org/wiki/Main_Page
- Planet OSM http://wiki.openstreetmap.org/wiki/Planet.osm
- Twitter @openstreetmap
- QGIS
- http://www.qgis.org/wiki/Using_OpenStreetMap_data
- OSM → PostGIS

BIM workflow

- BIM enable **Everyone** - access - **All Project Data** at **Anytime**

(**C**ommon **D**ata **E**nvironment)

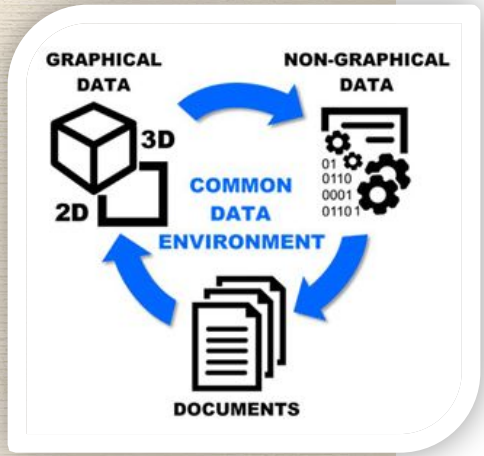
(BIM **platform**)

Cloud-based.

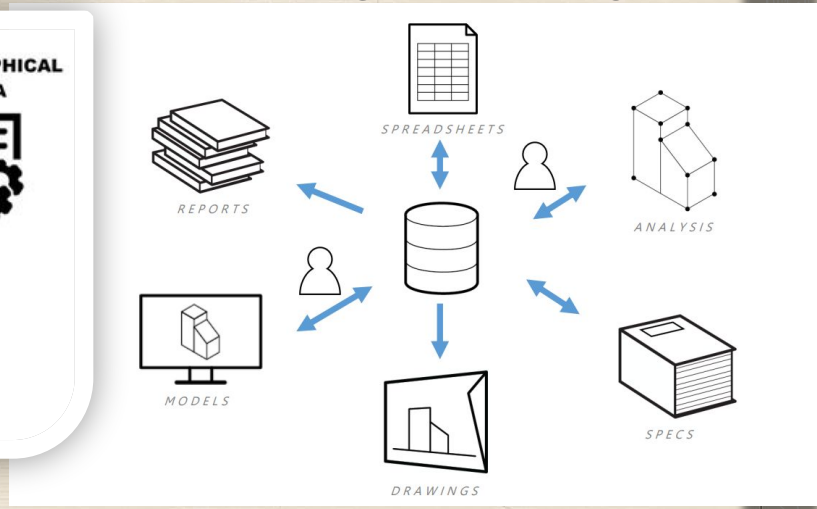
Manage user access.

Host different file formats.

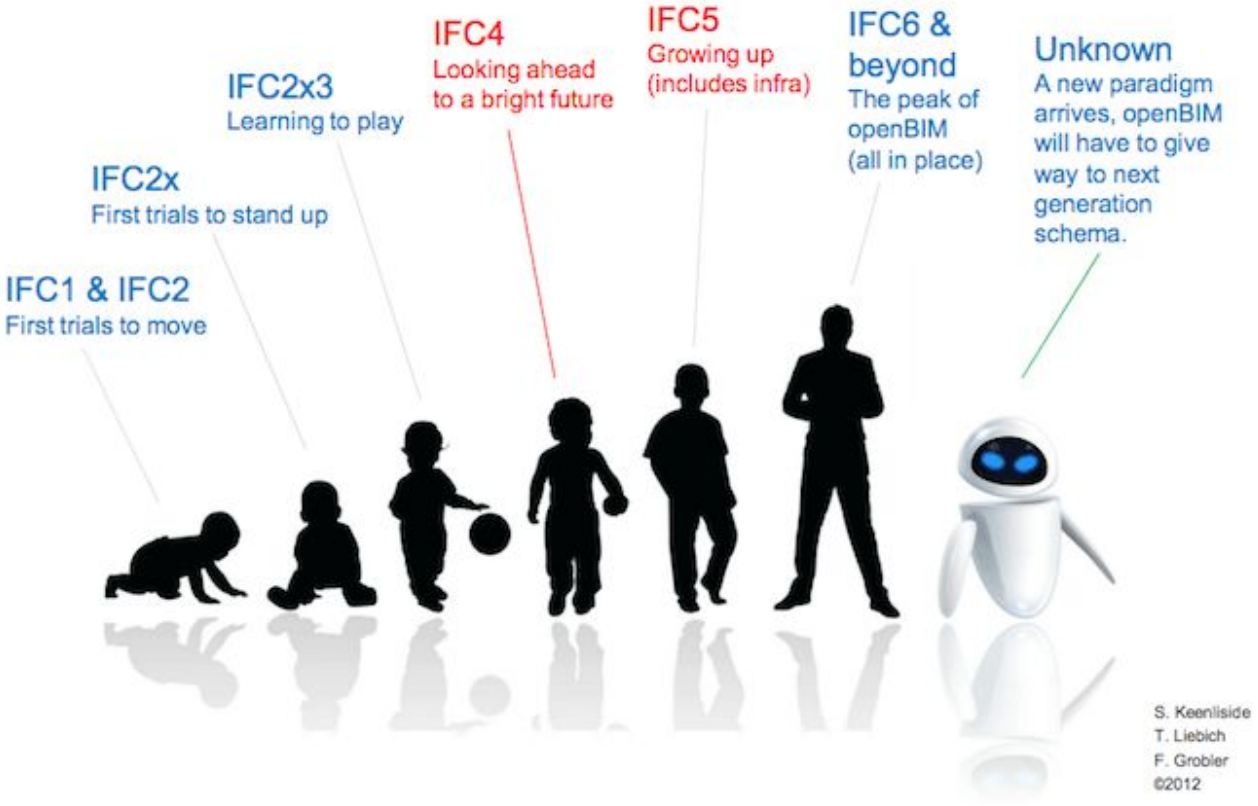
Integrate a 3D BIM model viewer.



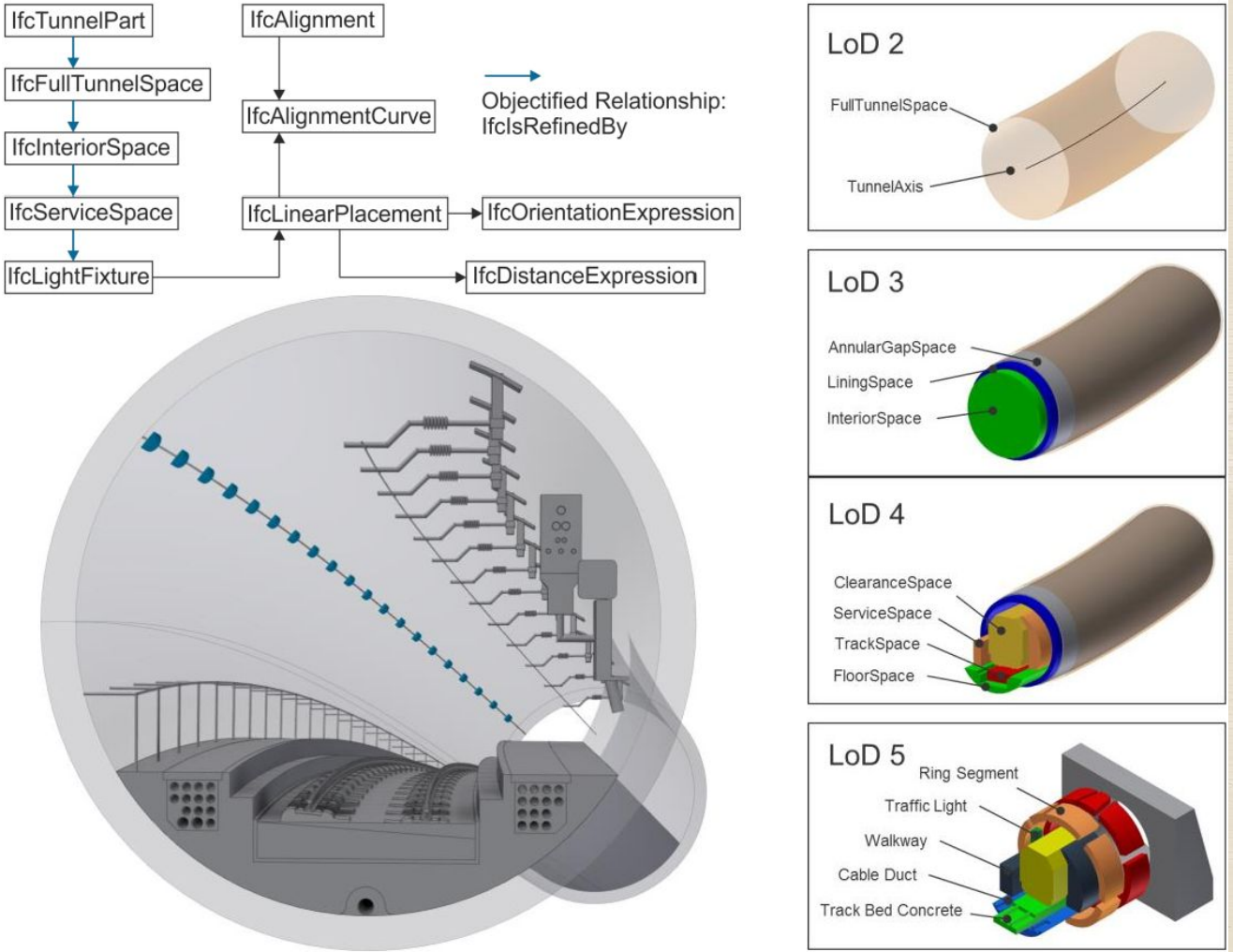
INTEGRATED DATA MODEL



BIM is about sharing information and working together



© 2014 AEC3 Deutschland GmbH

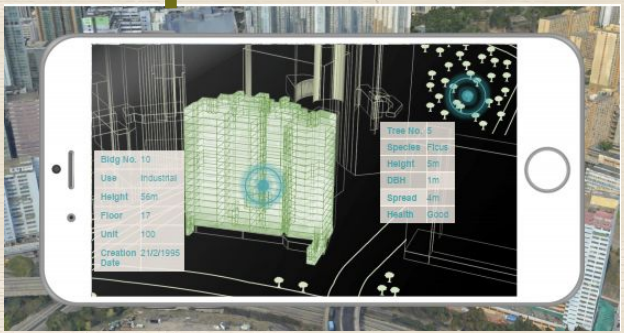

IfcTunnelPart
IfcFullTunnelSpace
IfcInteriorSpace
IfcServiceSpace
IfcLightFixture
IfcAlignment
IfcAlignmentCurve
IfcLinearPlacement
IfcOrientationExpression
IfcDistanceExpression
Objectified Relationship:
IfcIsRefinedBy
LoD 2
FullTunnelSpace
TunnelAxis
LoD 3
AnnularGapSpace
LiningSpace
InteriorSpace
LoD 4
ClearanceSpace
ServiceSpace
TrackSpace
FloorSpace
LoD 5
Ring Segment
Traffic Light
Walkway
Cable Duct
Track Bed Concrete

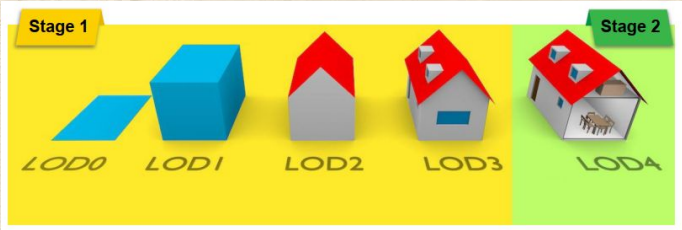
3 Stages of 3D Digital Map Development

Stage 1
- 3D maps for visualization

Stage 2
- 3D maps for floor/unit-based indoor applications

Stage 3
- 3D maps for city modelling

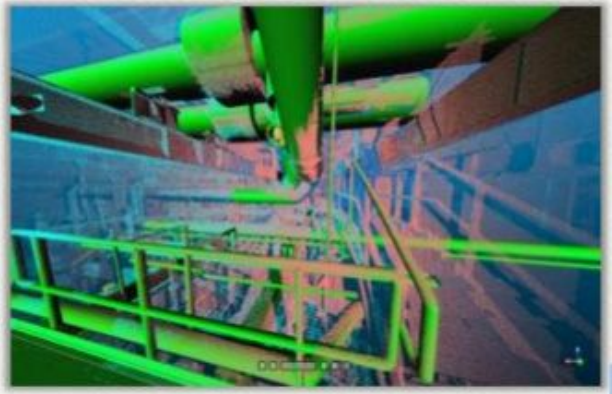




With a *BIM for Sustainable Cities* plan, municipalities are better able to:

- Coordinate with architects, engineers, contractors and others
- Better share digital design information, geospatial data, infrastructure models and other documentation among staff and project stakeholders
- Use that information to accurately predict performance, appearance and cost
- Reliably deliver municipal projects faster, more economically and with reduced environmental impact
- Leverage model-based design information for operation and maintenance

LiDAR/Laser Scan to BIM

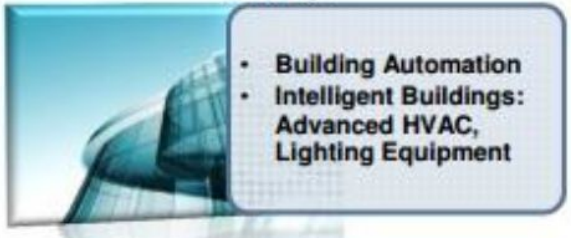


- Creating of 3D BIM models with point cloud data generated from laser scanning
- Production of as-built CAD drawings from the generated models
- Beneficial for Renovation, Refurbishment / Retrofitting of existing structures

Smart Energy: Digital Management of Energy

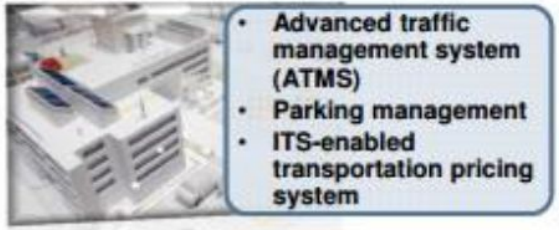
- Smart grids
- Smart meters
- Intelligent energy storage

Smart Buildings: Automated Intelligent Buildings



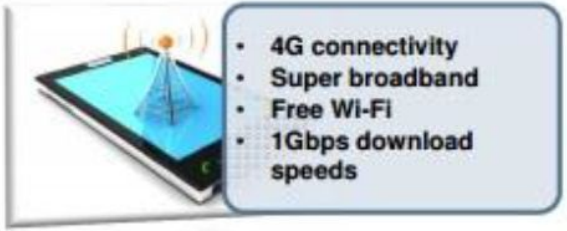
- Building Automation
- Intelligent Buildings: Advanced HVAC, Lighting Equipment

Smart Mobility: Intelligent Mobility



- Advanced traffic management system (ATMS)
- Parking management
- ITS-enabled transportation pricing system

Smart Technology*: Seamless Connectivity

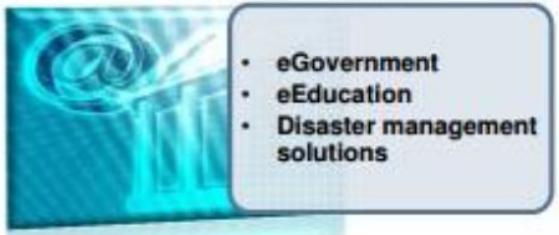


- 4G connectivity
- Super broadband
- Free Wi-Fi
- 1Gbps download speeds

Smart Infrastructure: Digital Management of Infrastructure

- Sensor networks
- Digital water and waste management

Smart Governance and Smart Education: Government-on-the-Go



- eGovernment
- eEducation
- Disaster management solutions

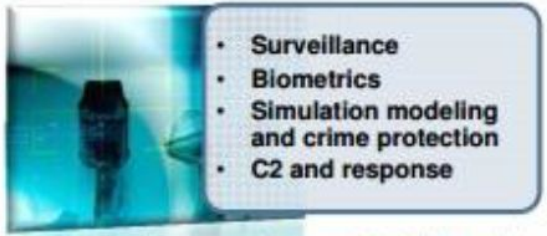
Smart Healthcare: Intelligent Healthcare Technology

- Use of eHealth and mHealth systems
- Intelligent and connected medical devices

Smart Citizen*: Civic Digital Natives

- Use of green mobility options
- Smart lifestyle choices

Smart Security: Next Generation 911



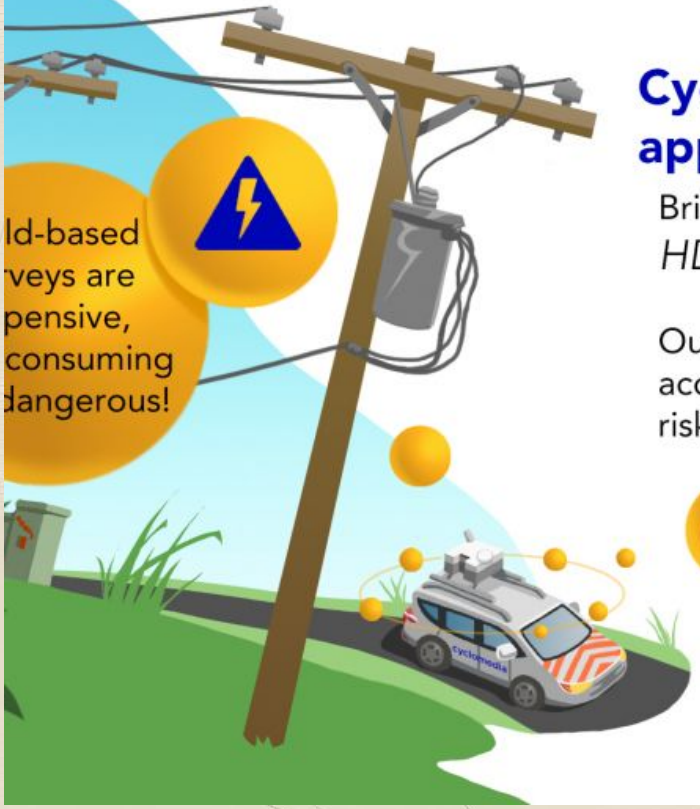
- Surveillance
- Biometrics
- Simulation modeling and crime protection
- C2 and response

*Smart citizen and smart technology are integrated and not covered separately in this analysis.

Source: Frost & Sullivan

The cyclomedia Solution Difference

VISUALIZE A BETTER WORLD



ld-based
rveys are
pensive,
consuming
dangerous!

Cyclomedia brings a modern approach to asset management

Bring the real world to your desktop with *HD 360° Imagery and LiDAR.*

Our solution creates a high quality, accurate asset database while lowering risk with fewer resources.

Cut your project timelines and costs in **HALF** compaired to traditional methods.

INTEGRA
WITH
Esri
Smallwo
AutoCA

Unp
Data
Gain insig
attachments & s

Accelerate asset in
with precise data for
vegetation n
reliability, and

ZENCITY

Type a word or a phrase

30 days | Export

ZenCity Insights

- Dashboard
- Topics
- Discourse
- Map
- Saved Items

Filters | Neighborhood: Entire City | + Advanced Filters

TRENDING TOPICS

Infrastructure 28%
Education 22%
Public Safety 10%
Local Businesses 8%
Community 5%
Environment 5%
Sports 5%
Municipal Services 4%
Transportation 4%
Public Spaces 4%
Culture and Events 3%
City Taxes 1%
Building and Planning 1%
Sanitation 1%
Building Maintenance 0%

POPULAR WORDS

SENTIMENT OVERVIEW

PROJECTS

Summer Night Lights 39%
Police Youth Academy 32%
River City High School Lockdown 22%
Boxing camp 7%

LEADING STORIES

4/16 11:23 am

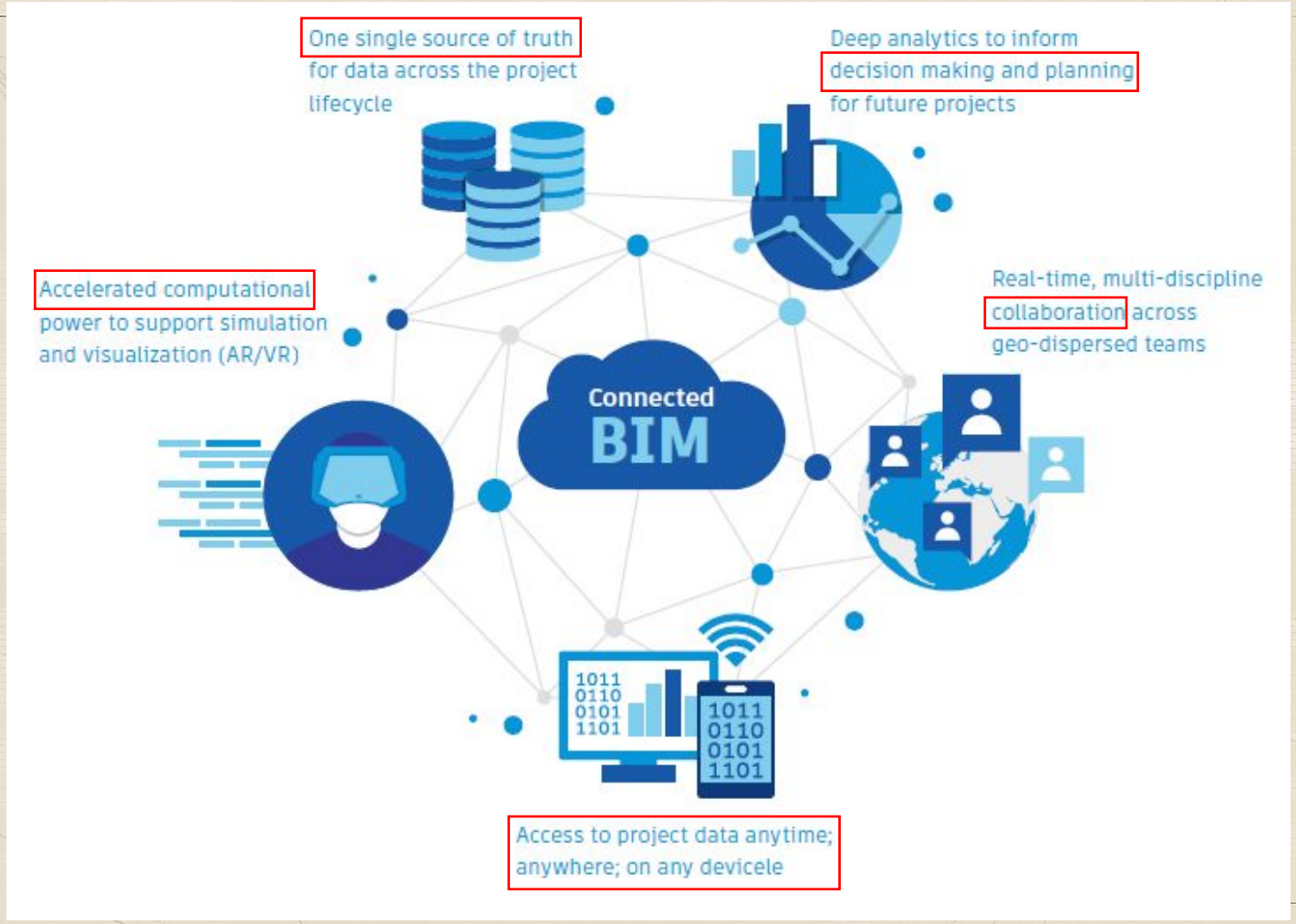
Transportation | Public Transportation

The voters of West Sacramento voted overwhelmingly to fund a new streetcar line linking our downtown (civic center/library/college/senior center/theater/community center & central business district), Raley Field, the Washington neighborhood, the Bridge District, and the riverfront with Old Sacramento, the rail station, the Golden 1 Center, downtown Sacramento, and Midtown.

137 | 13 | 7

MAP

Leading Topics | by Topic | by Type | Heat map


One single source of truth for data across the project lifecycle
Deep analytics to inform decision making and planning for future projects
Accelerated computational power to support simulation and visualization (AR/VR)
Real-time, multi-discipline collaboration across geo-dispersed teams
Connected BIM
1011
0110
0101
1101
1011
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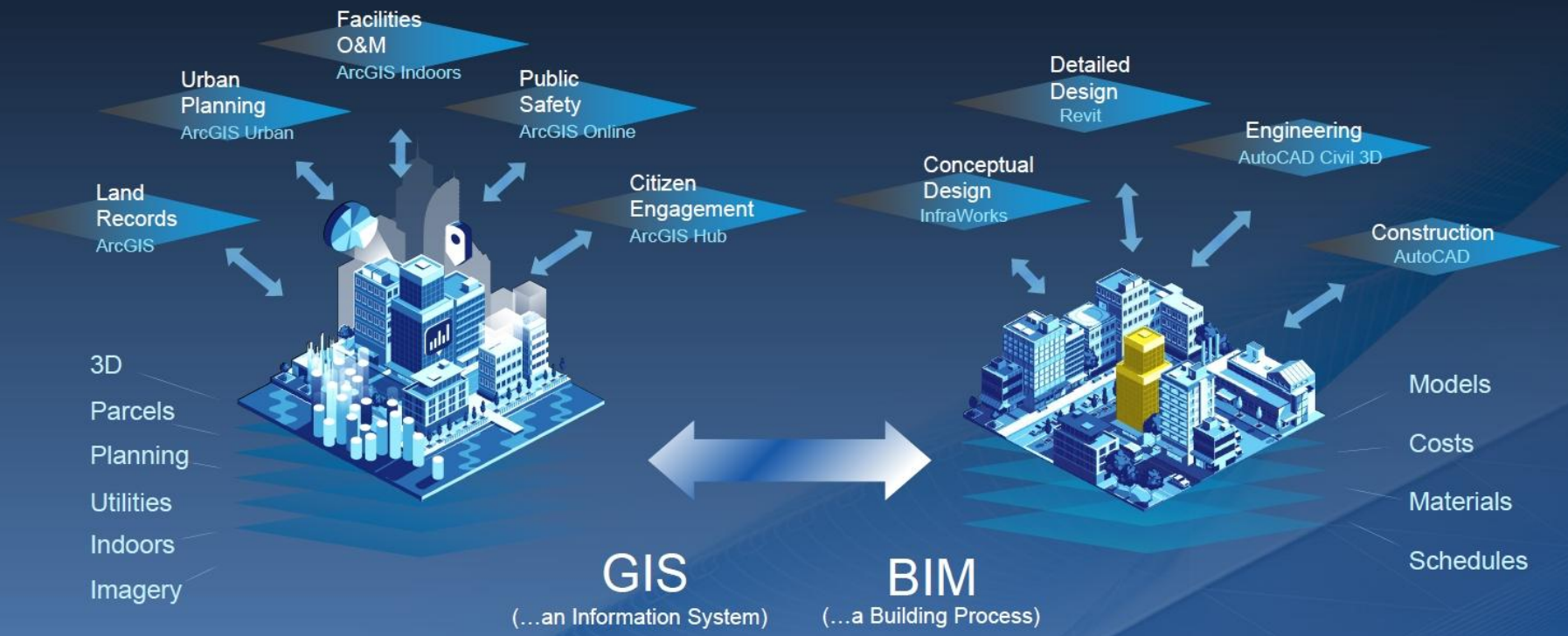
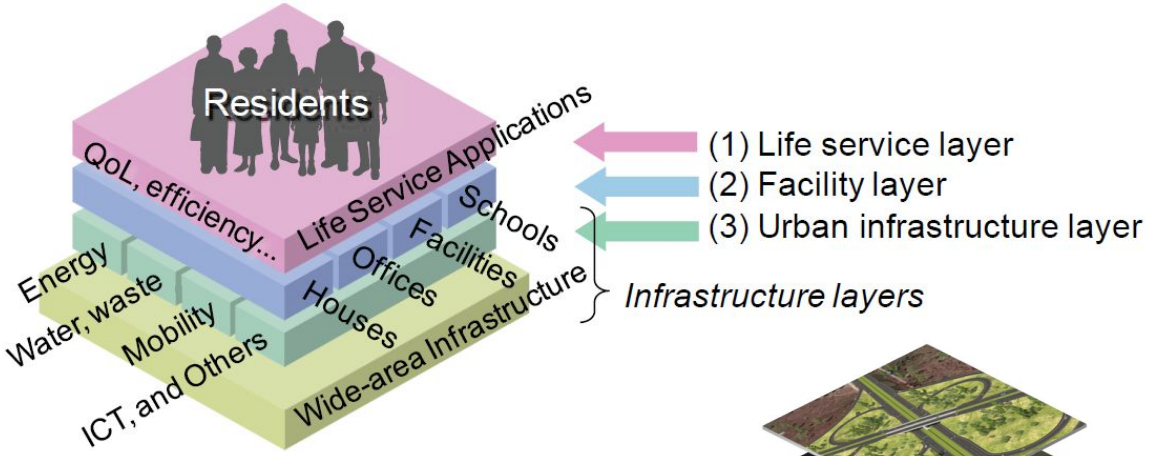
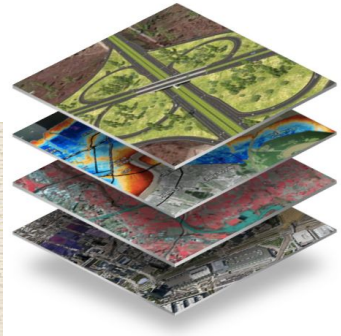
0101
1101
Access to project data anytime; anywhere; on any devicele

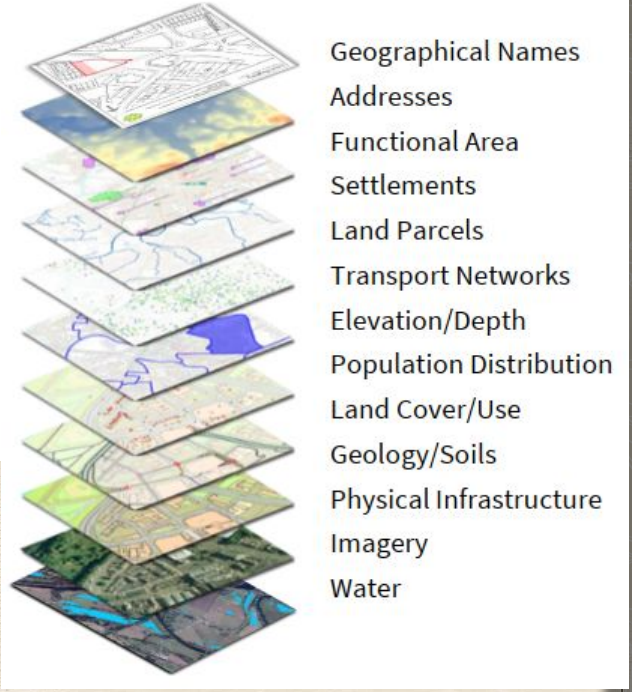
Smart Cities and Infrastructure with GIS and BIM

Technology integration leads to smarter more efficient cities









Three layer model of city functions

Citizen engagement
Issue identification and prioritisation

+

Data collection
Right data, at the right time

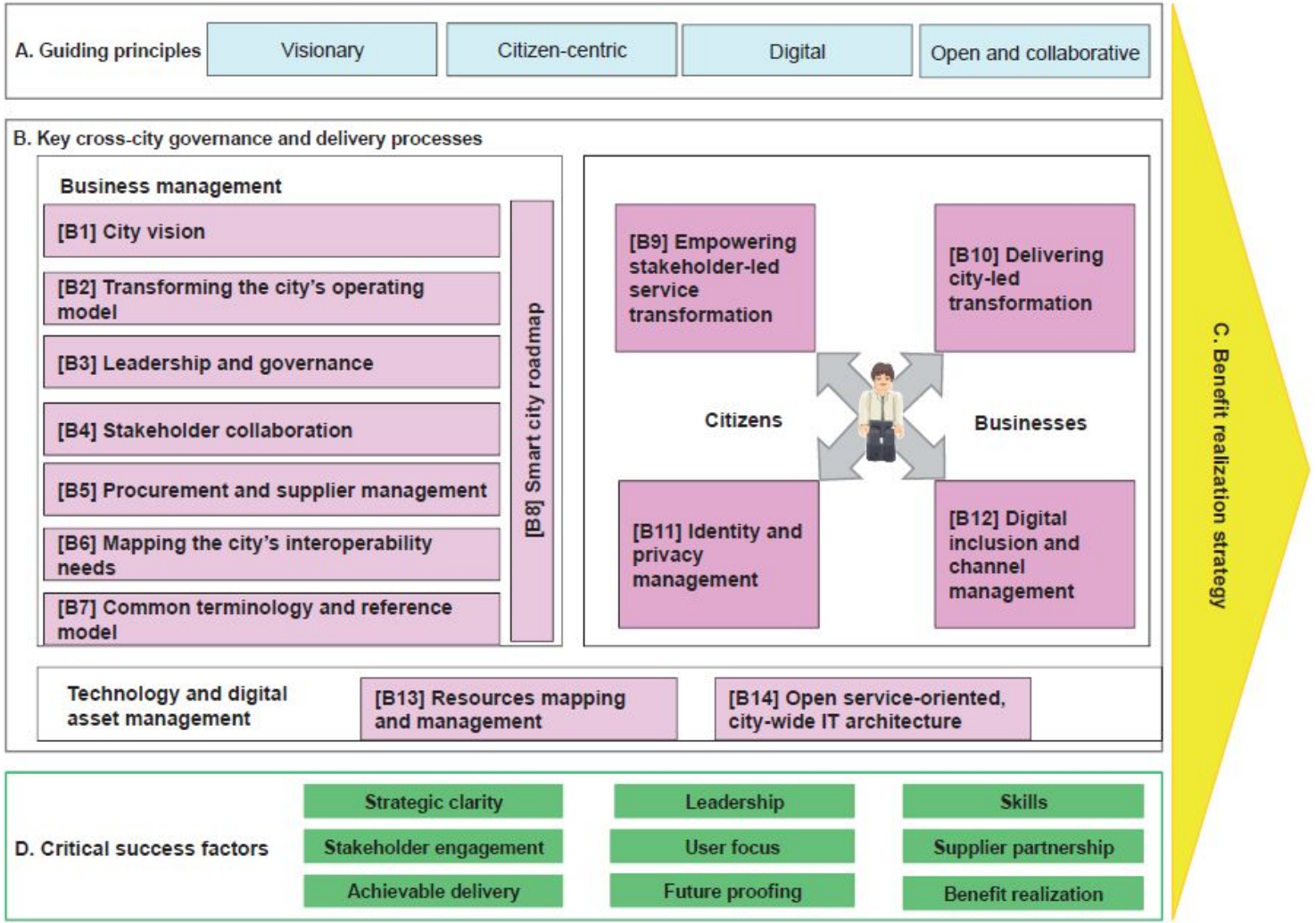
+

Technology
Identifying the right technology to do the job

=

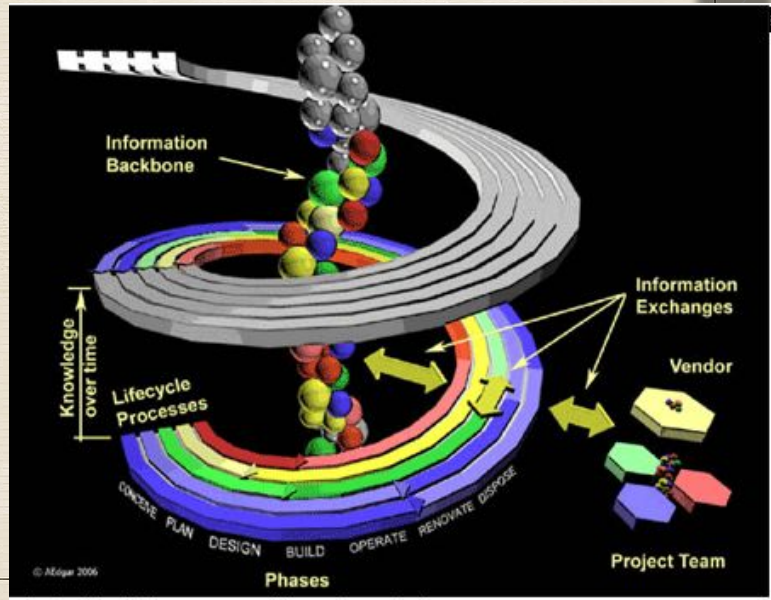
Optimum solutions and value

The smart city framework



BIM and Urban Planning and Design

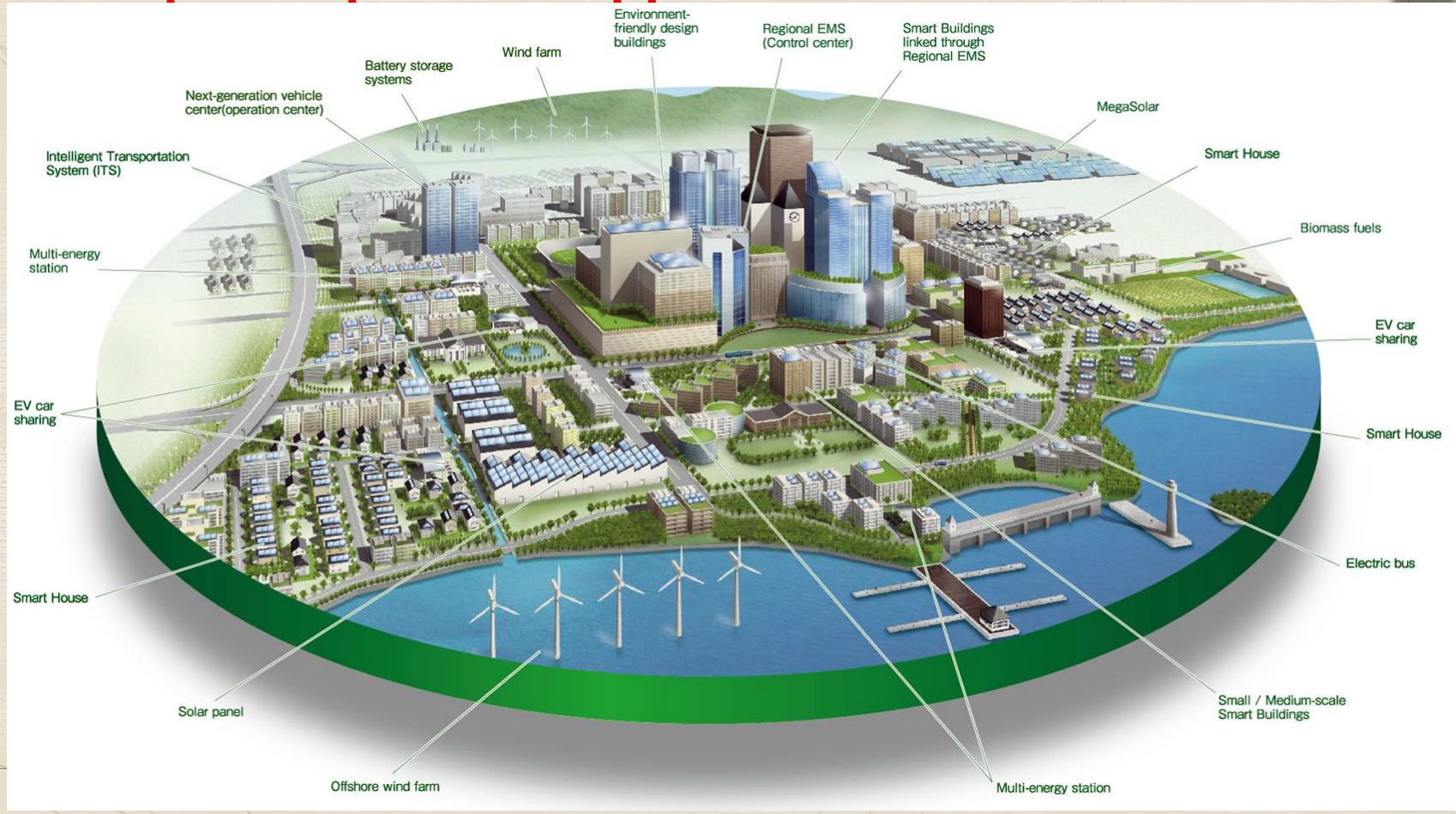
Omar Selim

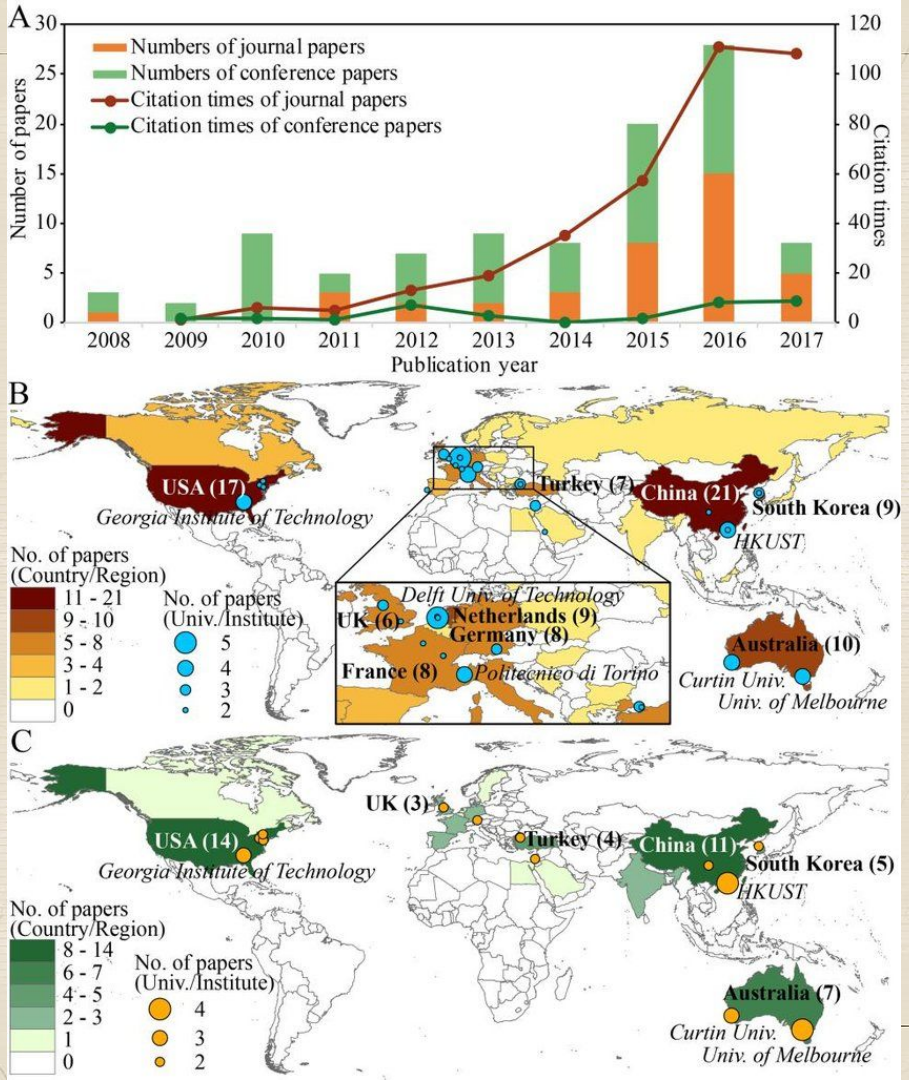


A·helical·building·process·lifecycle·model↵

Image from http://www.egeomate.com/understanding-the-bim-concept-from-the-bentley-systems-perspective/

International and regional experiences





Trends and worldwide distributions of BIM-GIS integration during the past ten years. (A) 149 Trends of publications; (B) Map of publications; and (C) Map of SCI/SSCI indexed journal papers.

A *BIM for Sustainable Cities* plan is part of a 3D digital cities initiative and depends on the convergence of CAD, GIS and BIM and the integration of...

- Modeling and Design
- Surveying & Data Collection
- Planning, Site Selection & Conceptual Design
- Clash Detection, Simulation and Analysis
- Visualization
- Multidiscipline Coordination
- Construction & Construction Management
- Operation and Maintenance

- 3D digital representations of infrastructure
- Includes descriptive info (dimensions, materials, manufacturers, etc.)
- Aids in proper design, construction, operation, and maintenance
- Drawback: files size and complexity make data difficult to repurpose

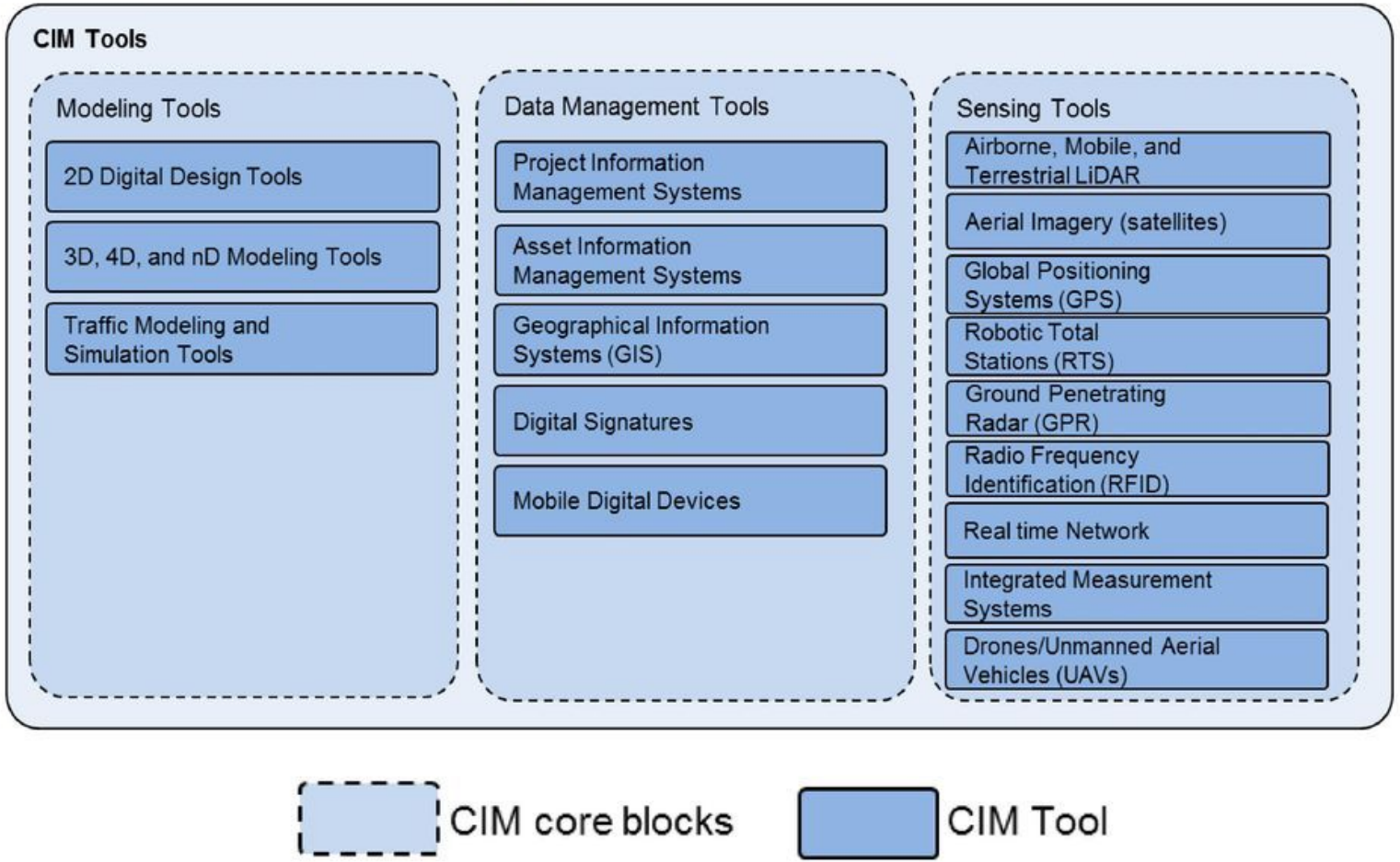
➔ Map and analyze geographic features

➔ Uses location and imagery

➔ Conveys data on a large scale

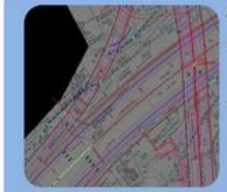
➔ Data models, attributes, simple geometries, and domains

CIM Utilizes Many Tools



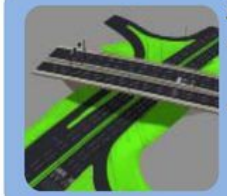
CIM Tools – Modeling

- Create virtual/digital representations of project data



2D Digital Design Tools

- Tools that agencies use for design data exchange and organization
- Some examples include plans, specifications, and 2D CAD files



3D, 4D, and nD Modeling Tools

- Tools to create 3D/4D/5D models for design and visualization.
- Resolving spatial conflicts among design entities (e.g. utility conflicts) and construction activities (temporal conflicts)

Traffic Modeling and Simulation Tools

- Tools used to conduct studies through simulation at macroscopic (state or regional) or microscopic (roadway) level
- Used for Impact studies (e.g. traffic delays) and aids public information when combined with design visualization

CIM Tools – Data Management

- Software to manage project information throughout design, construction, and maintenance lifecycle

Project Information Management Systems

- Manages & allows sharing of documents, databases, model-based data during project delivery processes
- Includes document management systems for contract administration, daily work monitoring, and overall project management

Asset Information Management Systems

- Used for archiving asset data after construction and supports inventory asset management during O&M lifecycle
- Also assists future project development.

Geographical Information Systems (GIS)

- Associates databases with geospatial positioning information
- Offers benefits for planning and programming, environmental assessment, surveying, and asset management

Digital Signatures

- Electronic signatures secured with encryption technology
- Eliminates need to print, sign, and scan and allow continuous flow of digital documents

Mobile Digital Devices

- Allows field access of digital documents
- Eliminates need to carry all the paper copies of plans, Specifications, Standards required for inspectors of multiple projects

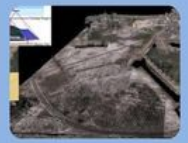
CIM Tools – Sensing

- Advanced Surveying tools improve coverage, speed, data accuracy, and can reduce costs.

Airborne, Mobile, and Terrestrial LiDAR

Laser scanning and measurement in three different configurations (static, mobile and airborne)

Uses: Accurate and dense point cloud data for design, quantity estimates, and 3D Models



Aerial Imagery

- Overlaps two grayscale photos taken from aircraft to provide 3D data
- Design and computation of earthwork, mapping, photogrammetry

Global Positioning System (GPS)

- 3D spatial coordinate data used for design & construction
- Mapping, surveying, Automated Machine Guidance.

CIM Tools – Sensing (cont'd.)

Robotic Total Stations (RTS)

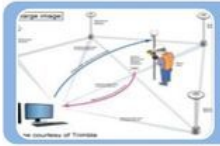
- Remote-controllable Total Stations from observation point (one-operator)
- Greater accuracy of measurements, used for AMG (final earthwork, paving, etc.)

Ground Penetrating Radar (GPR)

- Subsurface mapping using radio waves.
- Locate underground utilities, groundwater, tunnels, and other objects

Radio Frequency Identification (RFID)

- Tags/chips emit radio waves for tracking
- Track materials, equipment, utilities, etc.



Real Time Network (RTN)

- Continually Operating Reference Stations (CORS) for real-time positioning
- Surveying, AMG, QA/QC checks

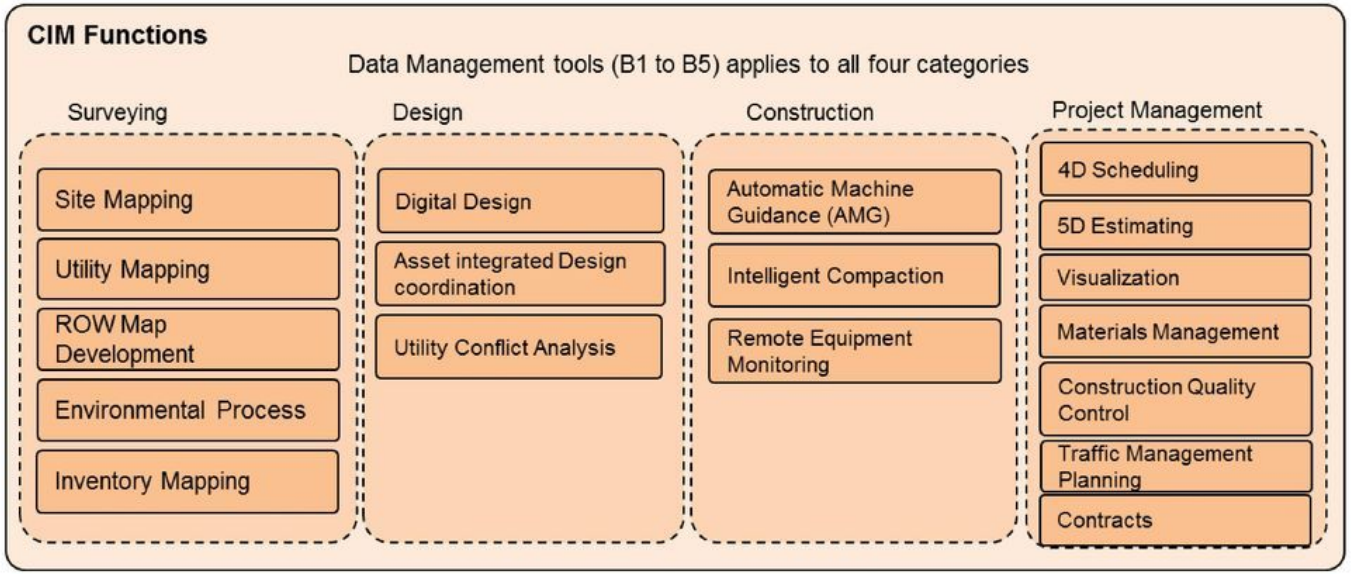
Integrated Measurement System (IMS)

- Feedback control system with sensors and GPS for temperature control
- Used for Intelligent Compaction (IC)

Unmanned Aerial Vehicles (UAVs)

- Drones collect geo-referenced images and point clouds for surveying and quality control
- Rapid data collection, high precision, image resolution

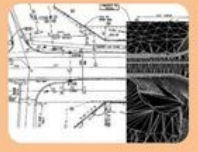
CIM Tools Affect Many Functions



Each CIM tool improves the performance, predictability or transparency in executing one or more CIM functions.

CIM Functions – Surveying

- CIM functions primarily related to *data collection and measurement* tasks for project development and asset management



Site Mapping

- Advanced surveying tools (LiDAR, drones, RTN for geospatial data collection)
- Expedite project development, tracking work progress, creating as-built records

Utility Mapping

- Utilizing tools such as RFID, GPR, and GPS to locate and store utilities data
- Resolve utility conflicts preconstruction and utility coordination process

ROW Map Development

- GIS and asset information systems to digitally record and manage files and plans

Environmental Process

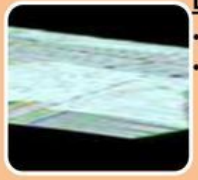
- GIS to expedite the impact assessment, enhance quality and credibility of data

Inventory Mapping

- GIS, GPS, and LiDAR to map and store assets in a more efficient way
- Track maintenance data of assets, digital records of existing assets

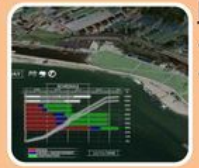
CIM Functions - Design

- Functions performing *design or design-related tasks* in project delivery process



Digital design

- 2D digital design tools and nD modeling tools
- Creation of digital models of terrain, project elements



Design Coordination and Asset data integration

- Using nD models for design and constructability reviews
- Integrating asset identification, attribute data for asset management

Utility Conflict Analysis

- 2D, 3D, nD modeling, and clash detection tools to detect conflicts
- Reduce Requests for Information (RFI), change orders, and claims.

CIM Functions – Construction

- Functions directly related to *construction* of a project

Automated Machine Guidance (AMG)

- 3D terrain models and GPS/RTS automate construction operations (excavation, grading, asphalt/concrete paving)
- Increases productivity and safety on-site, reduces rework, and helps in QA/QC checks

Inetlliegent Compaction (IC)

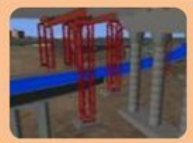
- GPS and IMS to promote efficient compaction of soils and pavements
- Improves quality of pavements
- May result in time/cost savings

Remote Equipment Monitoring

- Also known as Equipment Telematics
- Uses GPS/RTN connectivity to remotely monitor and control equipment operations
- Reduces idle time, increases utilization rate, optimizes labor productivity

CIM Functions – Project Management

- Other functions for *monitoring, controlling and managing* projects



4D Scheduling and 5D estimating

- Adds time (4D) and cost (5D) data to the 3D model
- Assists constructability analysis, scheduling, verifying payments, and estimating

Visualization

- GIS and nD modeling tools to enhance physical, geospatial or functional details of the model
- Communication and public information activities

Traffic Management Planning

- nD modeling and traffic simulation tools for preparation of traffic control plans

Construction Quality Control

- Mobile digital devices, RTN and Rover-based QA/QC checks
- Frequent and accurate creation of as-built records and good communication

Materials Management

- RFID and GPS technologies to manage materials on supply chain and on-site

Contracts

- Information management systems for contract administration and management (e.g. bid letting, RFIs, shop drawing reviews and approvals, submittals and correspondences)

Autodesk® Infrastructure Modeler
Traffic Calming and Green Space

STORMWATER MANAGEMENT OPTIMIZED
CONSTRUCTION PHASE
CONSTRUCTION SCHEDULE MANAGEMENT
75°F
4/12/14
11:38 AM
DATASET 1
DATASET 2
DATASET 3
03.27.2015

What makes a city smarter?

A smart city should monitor and integrate conditions of all of its critical infrastructures, from roads and bridges to major buildings

• to better optimize its resources

• plan its preventive maintenance activities and

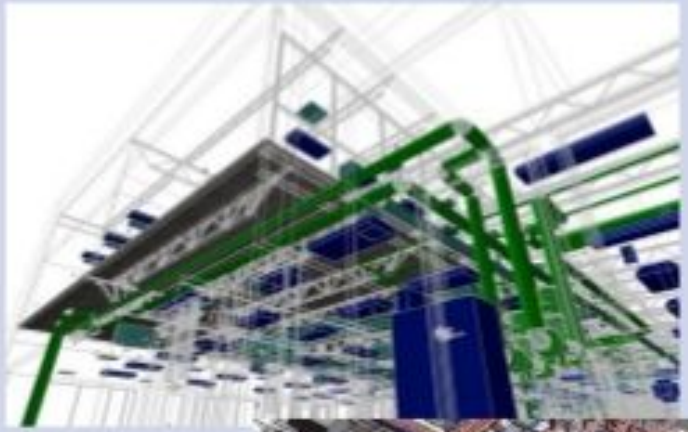
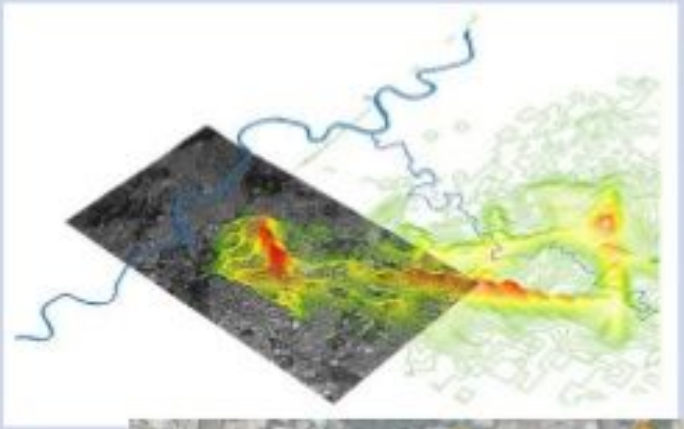
• monitor security aspects

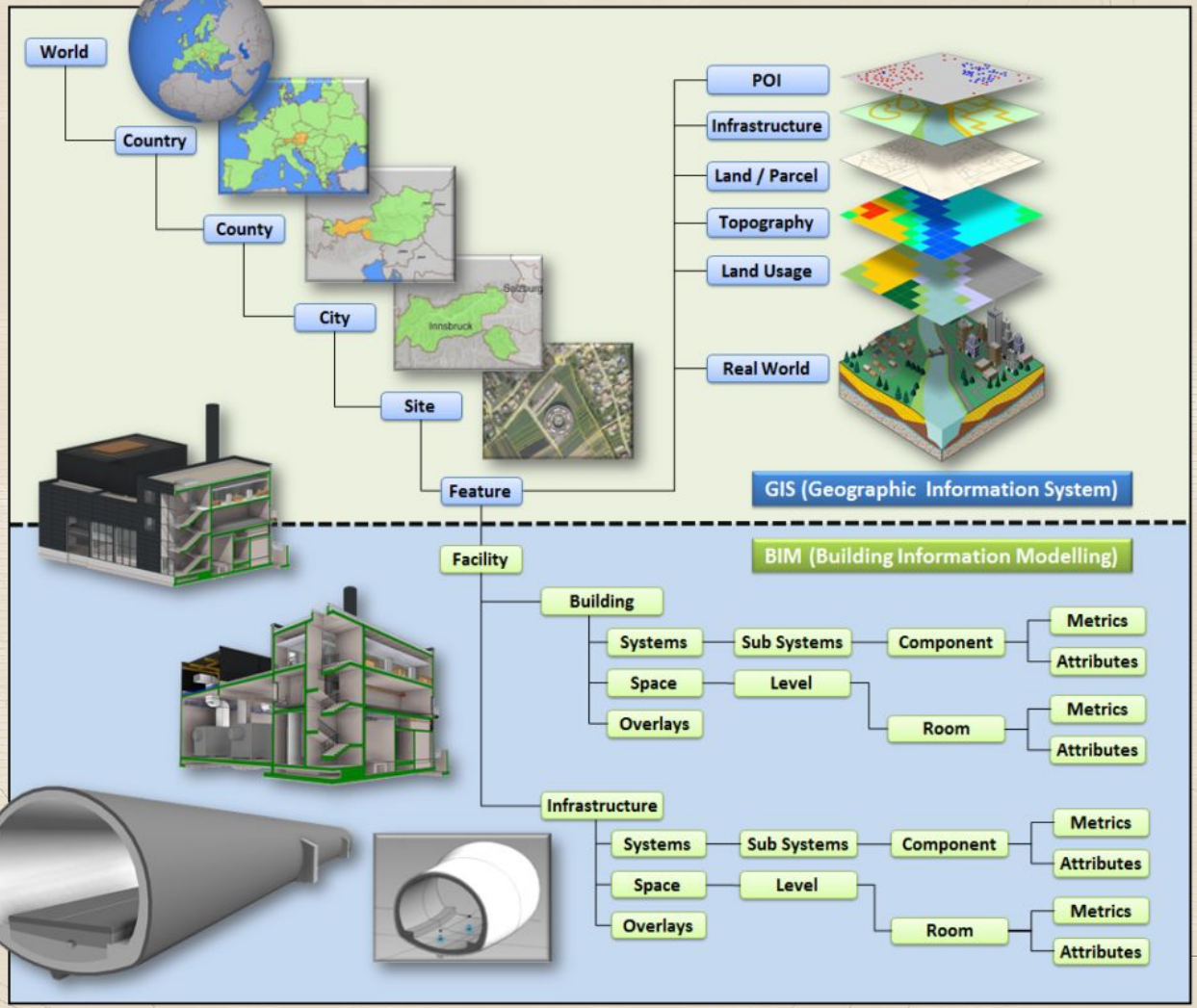
• Smart cities are a move from data silos to data sharing by creating a common object model

• By data sharing it can meet the needs of the many, whether utilities, transport providers, public health, emergency services, asset managers, urban planners, businesses and citizens

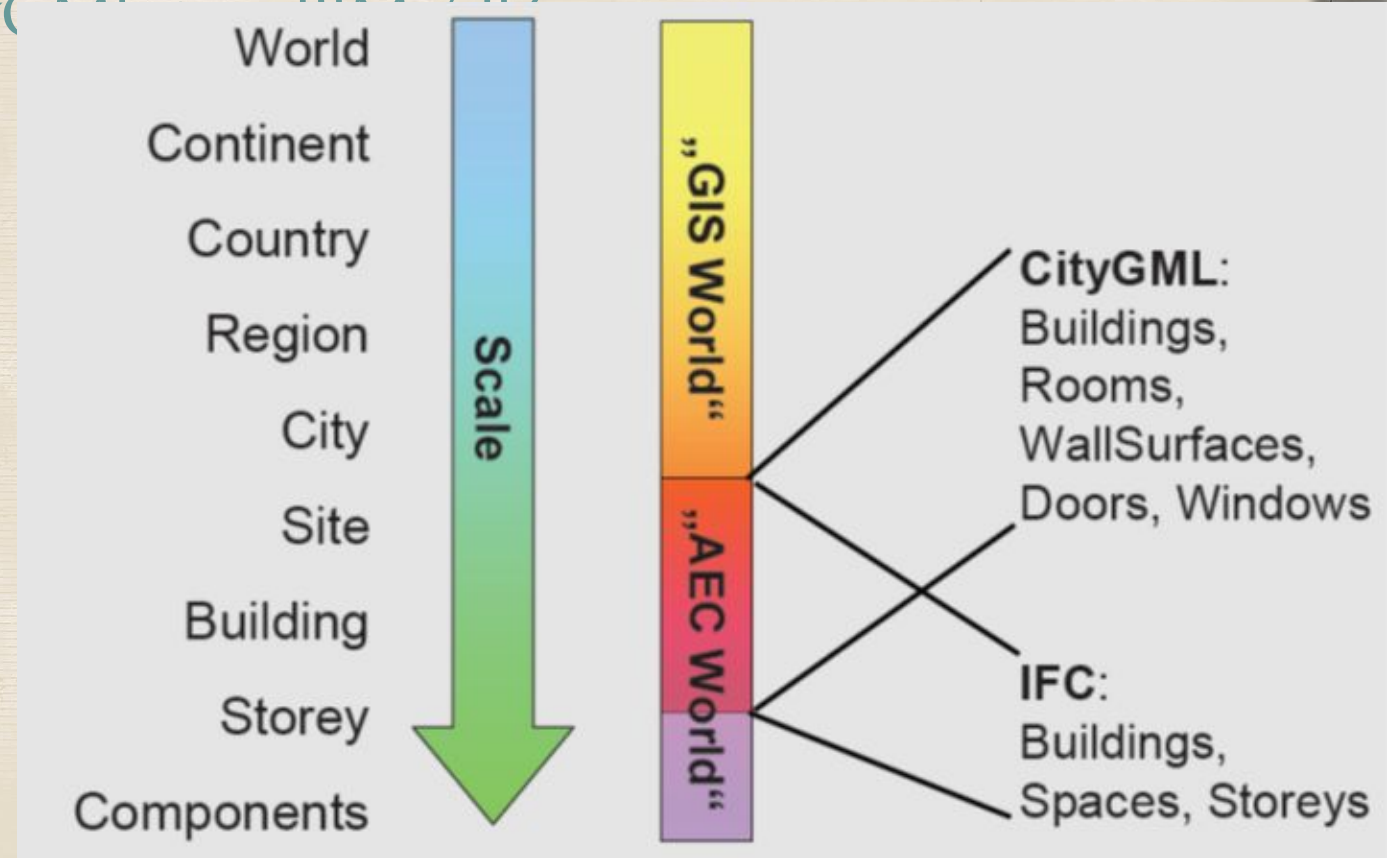
and... **TECHNOLOGY Makes It Happen**

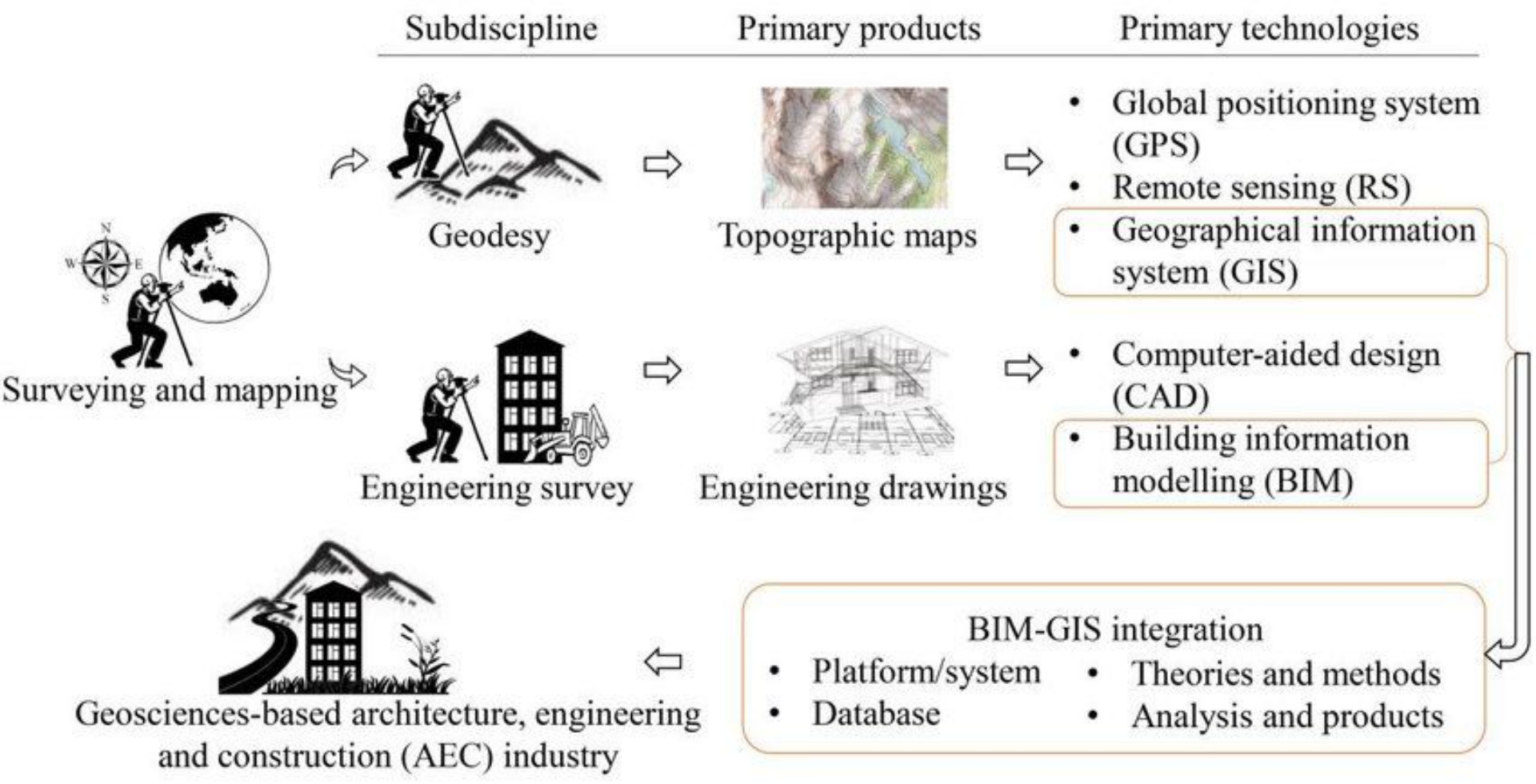
- BIM data and GIS data are xenogeneic data.

BIM data	GIS data
	

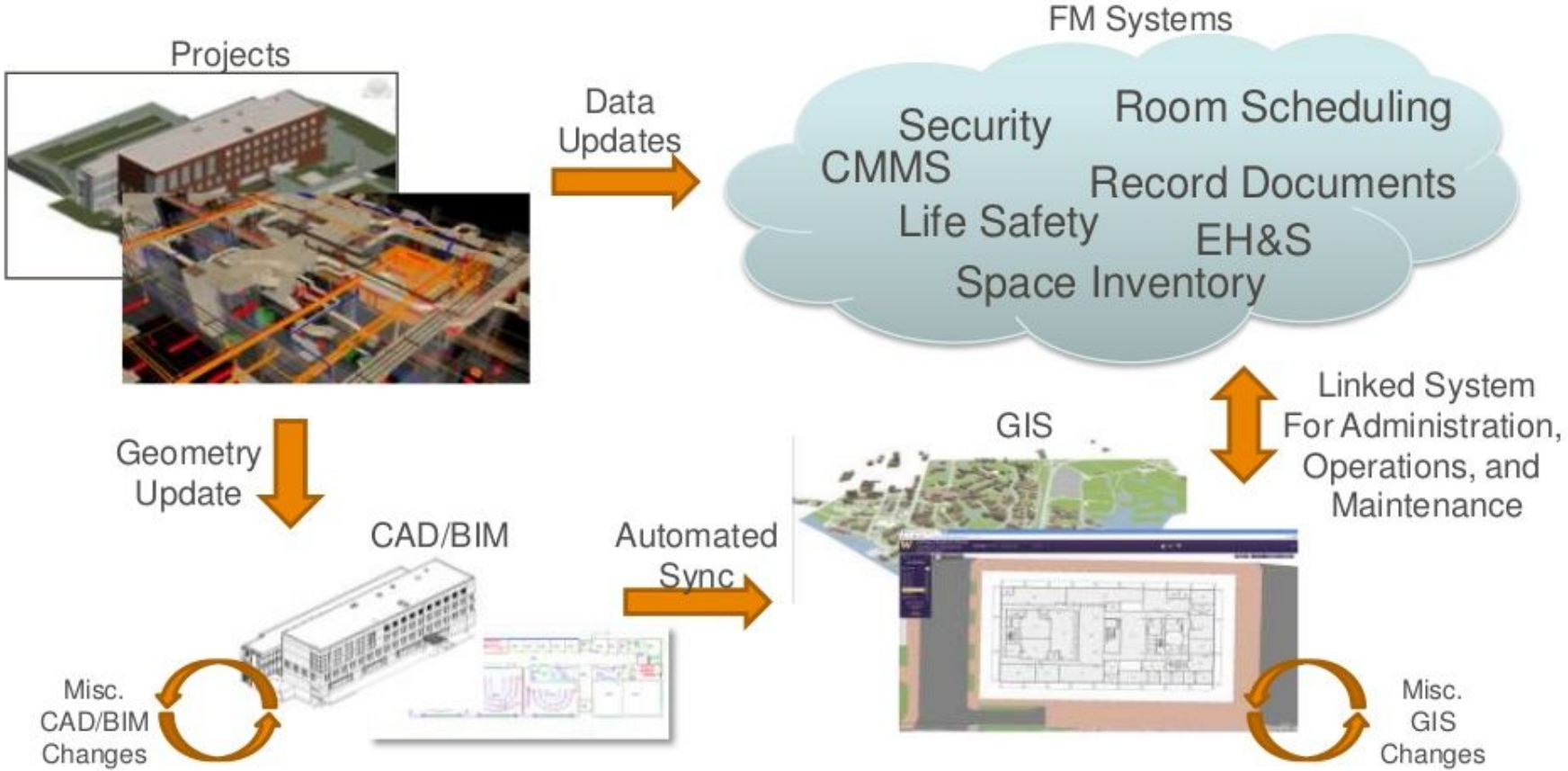

World
Country
County
City
Site
Feature
Salzburg
Innsbruck
POI
Infrastructure
Land / Parcel
Topography
Land Usage
Real World
GIS (Geographic Information System)
BIM (Building Information Modelling)
Facility
Building
Systems
Sub Systems
Component
Metrics
Attributes
Space
Level
Overlays
Room
Metrics
Attributes
Infrastructure
Systems
Sub Systems
Component
Metrics
Attributes
Space
Level
Overlays
Room
Metrics
Attributes

CityGML ... BIM / IFC



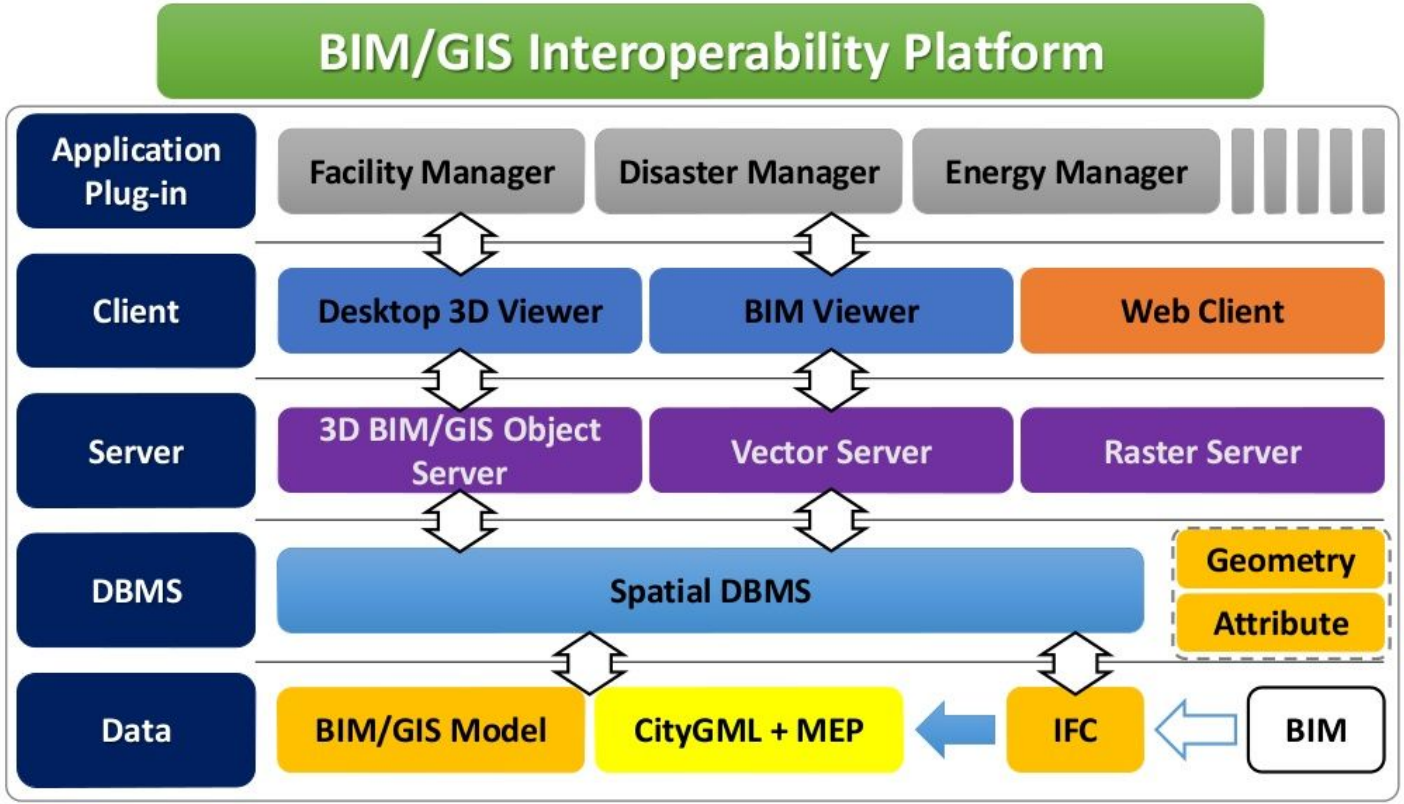


History of BIM-GIS integration from the perspective of surveying and mapping


Projects
Data Updates
FM Systems
Security
Room Scheduling
CMMS
Record Documents
Life Safety
EH&S
Space Inventory
Linked System For Administration, Operations, and Maintenance
GIS
Geometry Update
CAD/BIM
Automated Sync
Misc. CAD/BIM Changes
Misc. GIS Changes

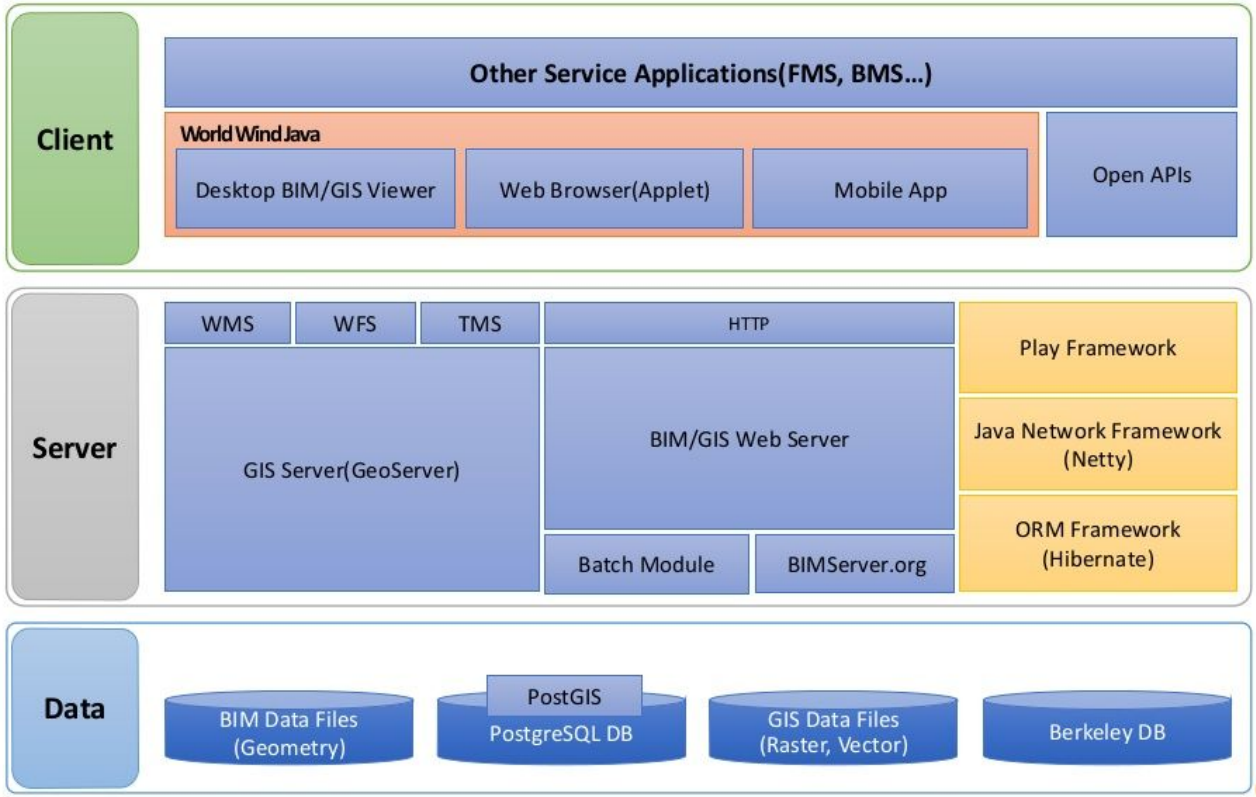
System Architecture for BIM/GIS Interoperability Platform

- For interoperable BIM on GIS platform, complicated system is required.



Platform Architecture

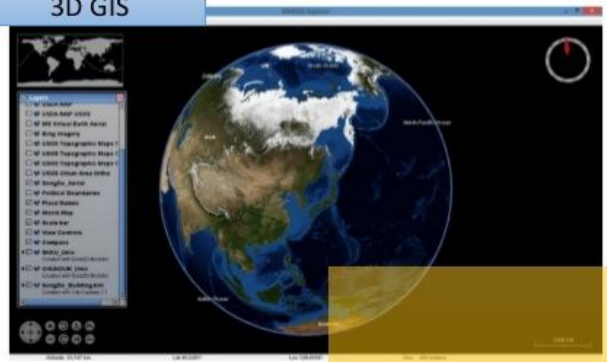
- Target platform should provide accessibility, interoperability, scalability, and compatibility.



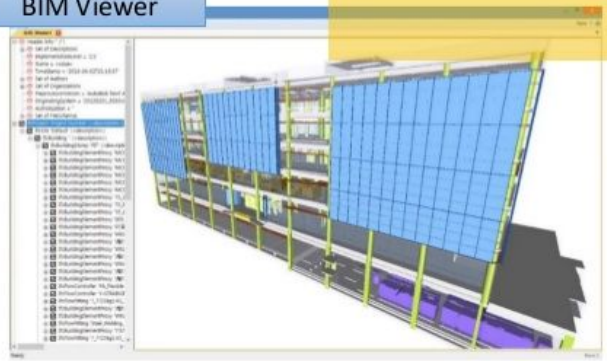
Client Development

- Out target is to integrate BIM data into 3D GIS data.

3D GIS



BIM Viewer



3D GIS + BIM

- Seamlessly connecting indoor and outdoor
- Interactively viewing inside and around the building
- Easily searching properties of the building

World Wind Java for 3D GIS

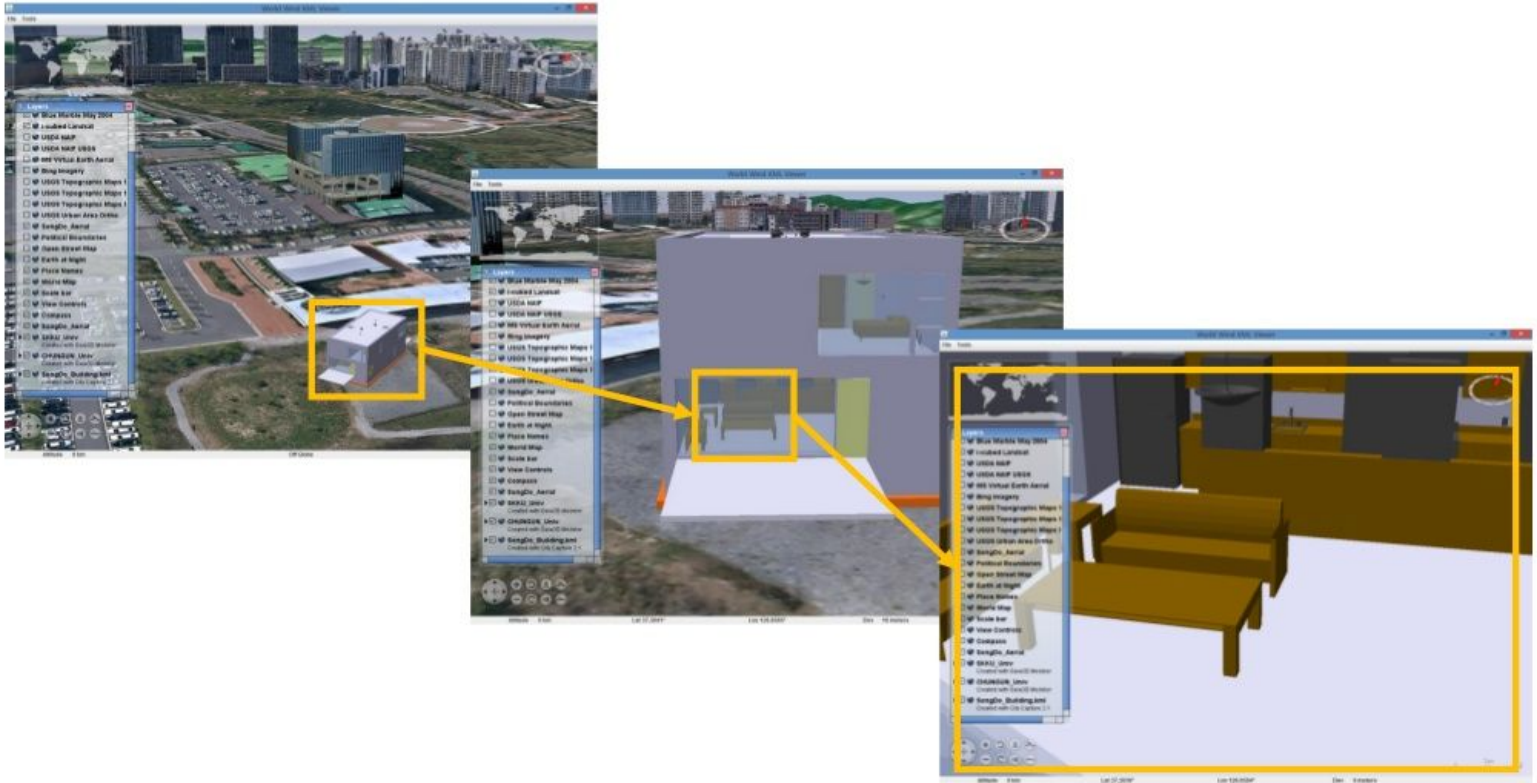
- World Wind is an open-source (released under the NOSA license) virtual globe developed by NASA and the open source community for use on personal computers.
- Old versions relied on .NET Framework, which only ran primarily on Microsoft Windows. The more recent Java version, World Wind Java, is cross platform.
- World Wind Java is a Software Development Kit (SDK) which is aimed at developers and is not a standalone virtual globe application in the style of Google Earth

Client Development

- Providing satellite image/aerial photo service using WMS (Web Map Service) from GIS server
- NASA Blue Marble Imagery, I-cubed Landsat Imagery, Aerial Photo(12cm Spatial Resolution)

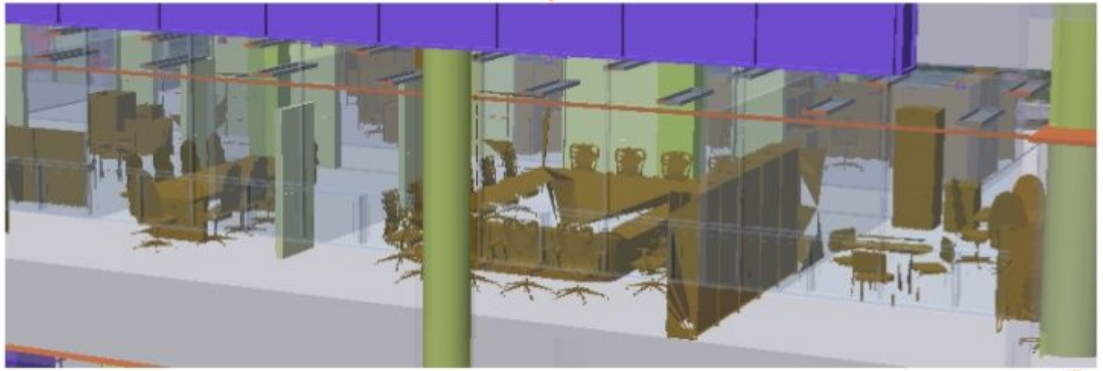
Client Development

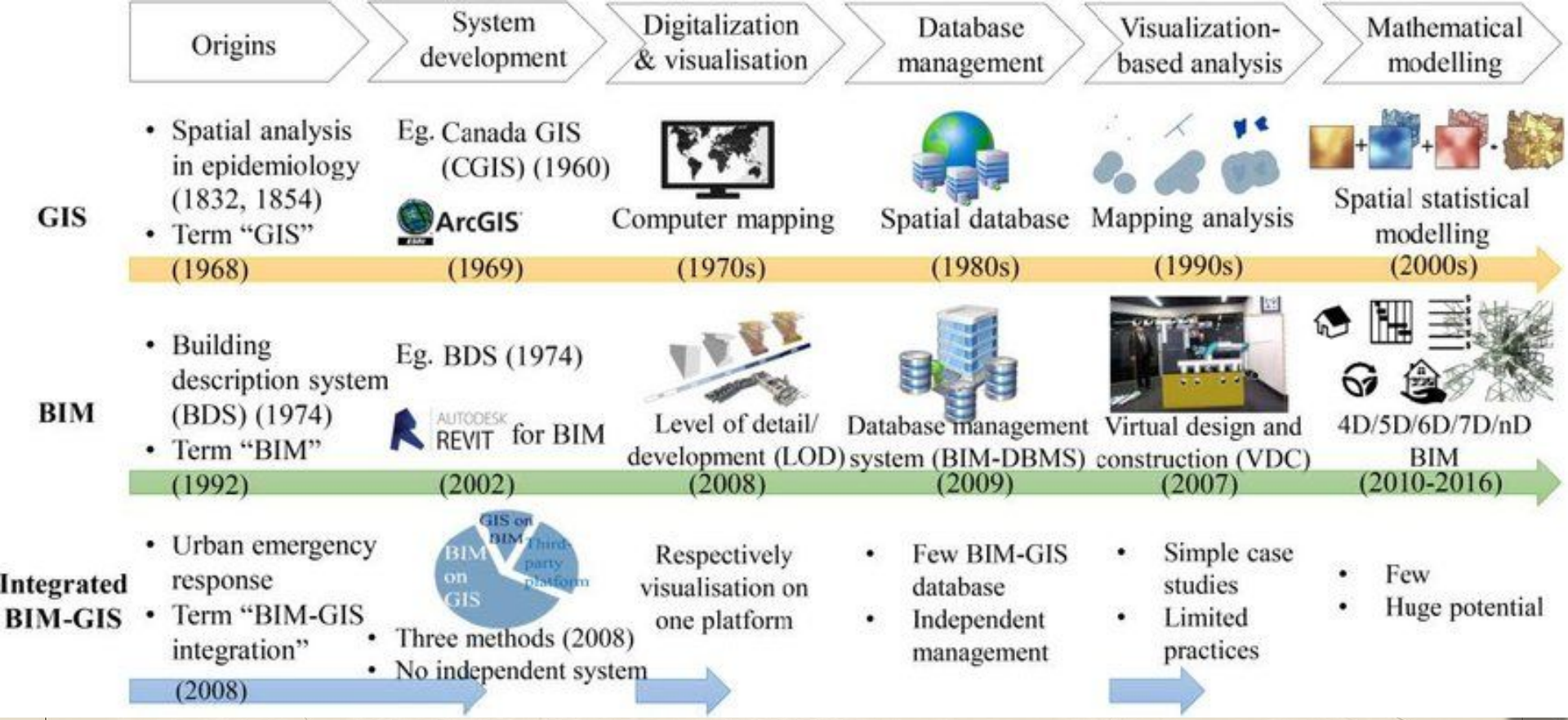
- Displaying inside and outside of building via BIM/GIS interoperability service
- Displaying BIM data with relative coordinate on absolute coordinate based WWJ based on georeference information of spatial data link model(G3D)



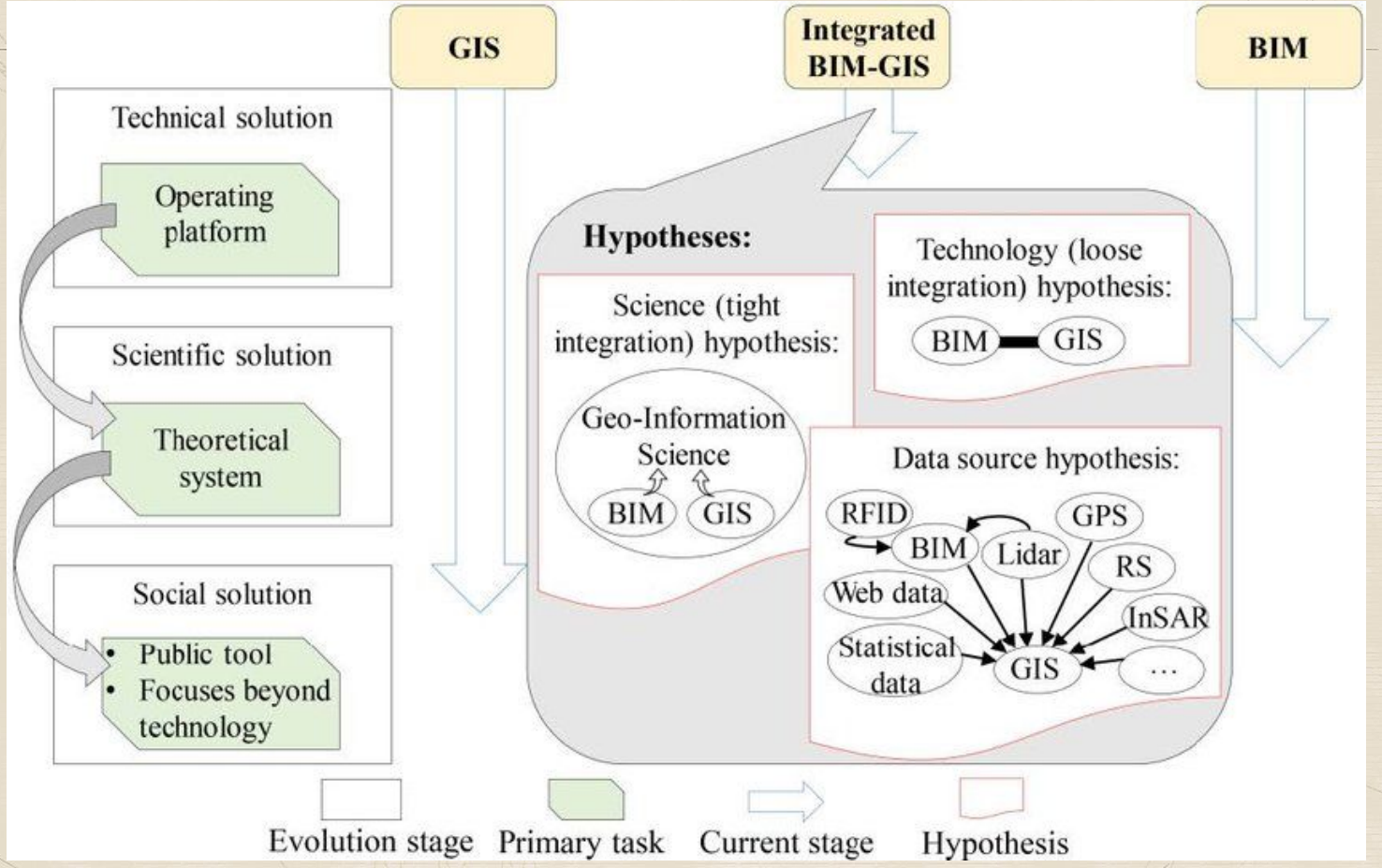
Client Development

- BIM data(IFC) visualization – Visualizing inside and outside building





Comparison of evolution progresses of GIS, BIM and integrated BIM-GIS

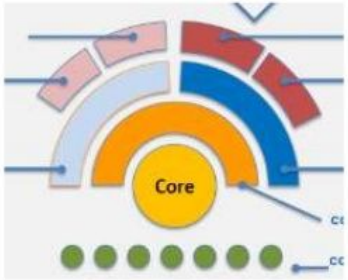


Hypotheses of future development of BIM-GIS integration

CityGML – the basics

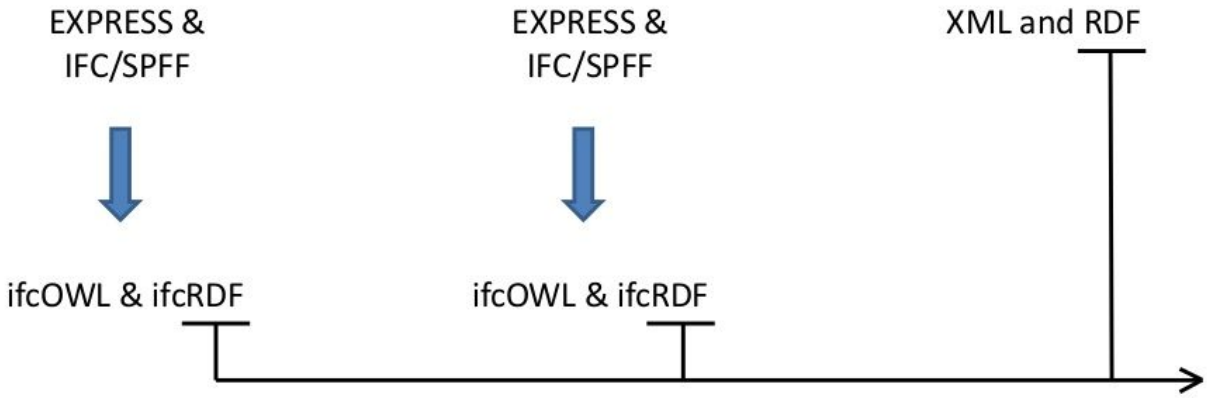
- Application independent topographic information model for virtual 3D city models
- Basic set of features defined
- Standardised meaning/interpretation of feature types (UML/GML)
- Comprises different themes – buildings, relief, water body, vegetation, landuse, appearance, city furniture, generic objects etc
- Data model (UML) ISO 191xx standard family
- Exchange format
- Realised as a GML3 application schema
- Applications – city planning, architectural design, environmental, telecoms, disaster management, estate management, etc
- August 2008 – cityGML version 1.0.0 accepted as an official OGC standard

BIM



INFRA

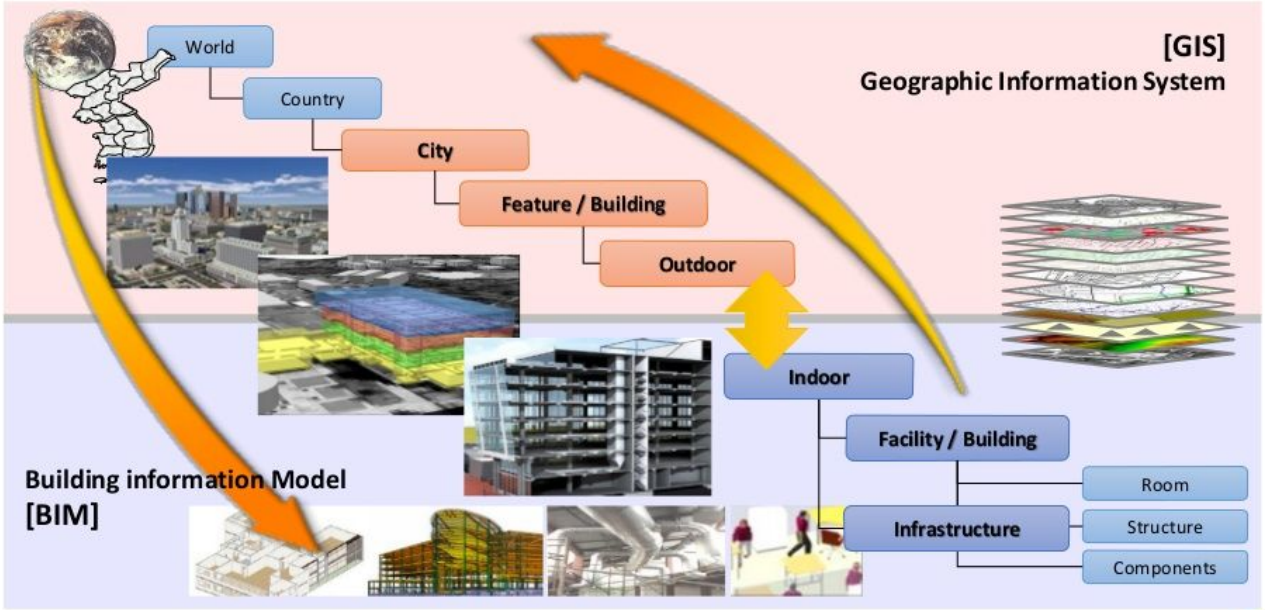
GIS



SOURCE: P. Pauwels & W. Terkaj. EXPRESS to OWL for construction industry: Towards a recommendable and usable ifcOWL ontology. Automation in Construction 63, pp. 100-133.

BIM on GIS project

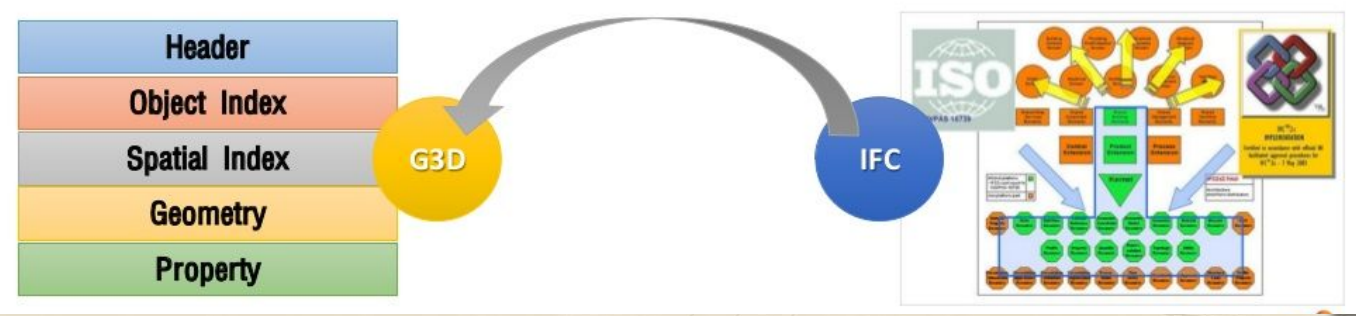
- Data model to integrate BIM data with GIS data to seamlessly and freely connect indoor to outdoor
- BIM and GIS interoperability platform for various applications and services
- Collaborative research project of Korea Institute of Construction Technology(KICT) and Gaia3D, Inc.,



Service Model of IFC for Interoperability

- Service Model: IFC conversion format for BIM/GIS interoperability
- G3D is designed for rapid display of big size IFC data based on GIS
- Characteristics of G3D
  - Including IFC geometry and property information
  - Relative coordinate + Georeference information(Latitude, Longitude, Altitude, Direction, Etc.)
  - LOD and spatial indexing information for rapid display
  - Geometry information based on file system
  - Property information based on database (ongoing)

Industry Foundation Classes (IFC) data model is intended to describe building and construction industry data. It is a platform neutral, open file format specification that is not controlled by a single vendor or group of vendors. It is an object-based file format with a data model developed by buildingSMART (formerly the International Alliance for Interoperability, IAI) to facilitate interoperability in the architecture, engineering and construction (AEC) industry, and is a commonly used collaboration format in Building information modeling (BIM) based projects



Designing Level of Detail(LOD)

- Newly defined LOD for BIM on GIS based on CityGML and BIM data type

Space	LOD	Geometry			Properties (Semantic LOD)
		BIM data	GIS data	Shape	
Outdoor	LOD0	-	▪ Only terrain data ▪ DEM+orthoimage		▪ None
	LOD1	▪ Boundary model ▪ Prismatic buildings ▪ Virtual texure	▪ DEM+orthoimage ▪ Prismatic buildings ▪ Virtual texture		▪ General properties
	LOD2	▪ Boundary model ▪ Simple roof structures ▪ Photorealistic texture	▪ DEM+orthoimage ▪ Simple roof structures ▪ Photorealistic texture		▪ Floor specific properties
	LOD3	▪ Boundary model +Parametric model ▪ Representation of precise Object ▪ Photorealistic texture	▪ DEM+orthoimage ▪ Representation of precise Object ▪ Photorealistic texture		▪ Exterior properties ▪ Facilities' exterior properties
Indoor + Outdoor	LOD4	▪ Boundary model +parametric model ▪ Building envelope	▪ DEM+orthoimage ▪ Representation of precise Object ▪ Photorealistic texture		▪ Building envelope properties
Indoor	LOD5	▪ Parametric model ▪ Building envelope	-		▪ All properties of buildings
	LOD6	▪ Furniture, MEP model ▪ Irregular shaped objects	-		▪ All properties of buildings

KICT

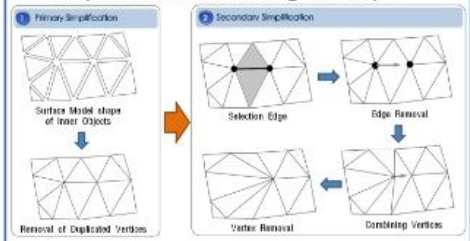
Technology for Rapid Display

- Simplification, Hierarchical, and Data Streaming are required for rapid display.

Simplification

Hierarchical LOD generation throughout applying simplification algorithm

- Simplification of building inside
- Simplification of building envelope



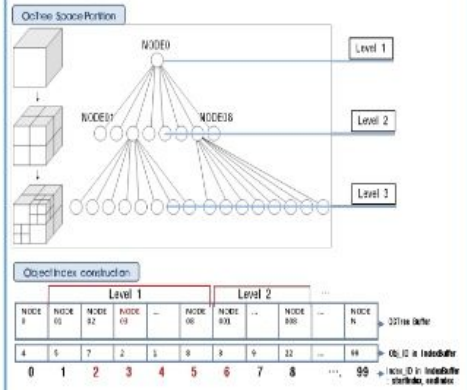
- Building inside objects simplification and LOD creation

- Building outside objects simplification and LOD creation

Hierarchical Data Structure

Data structure throughout spatial indexing based on Octree

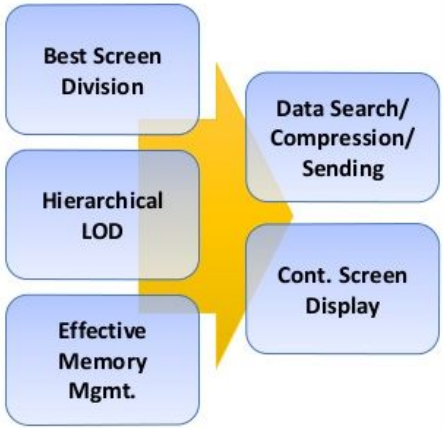
- Spatial division method based on Octree for spatial query about building objects
- Applies Octree to all LOD including interior and exterior

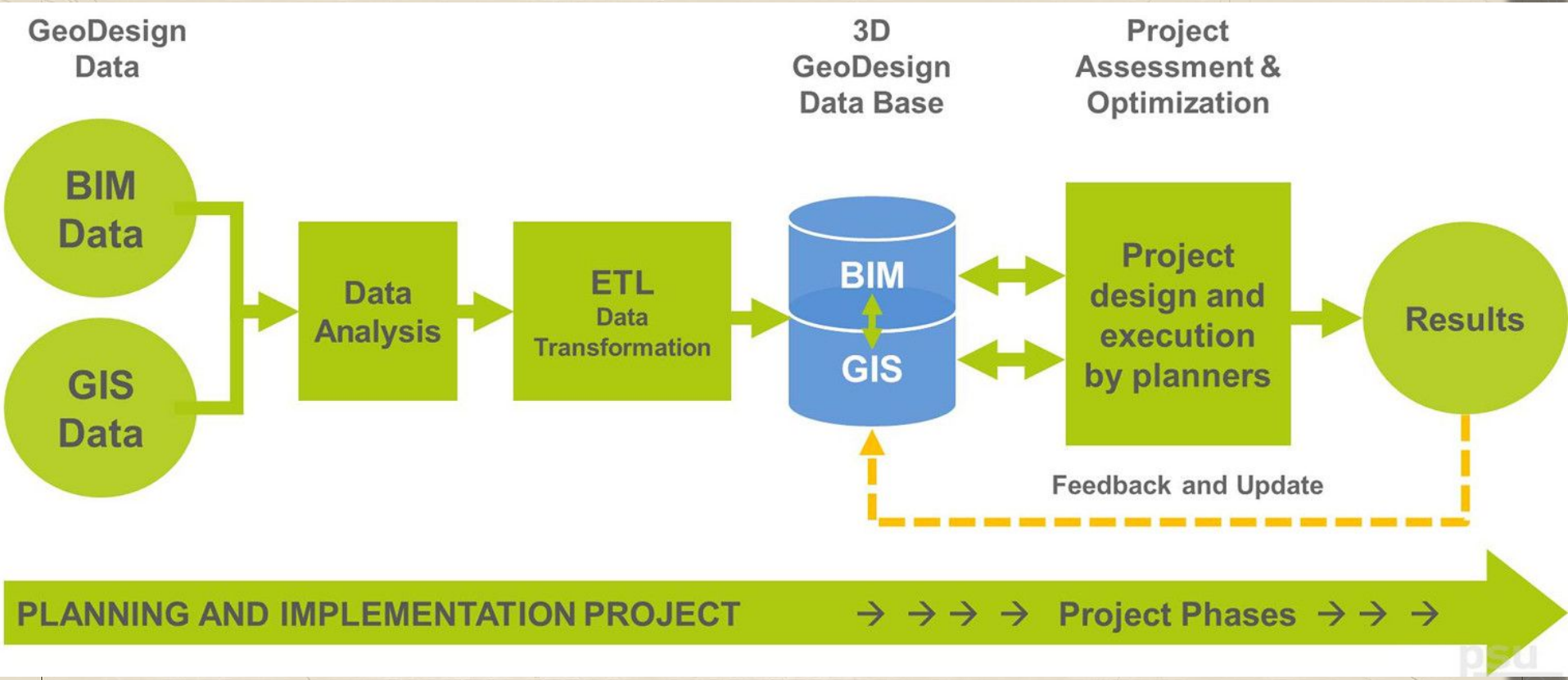


Data Streaming

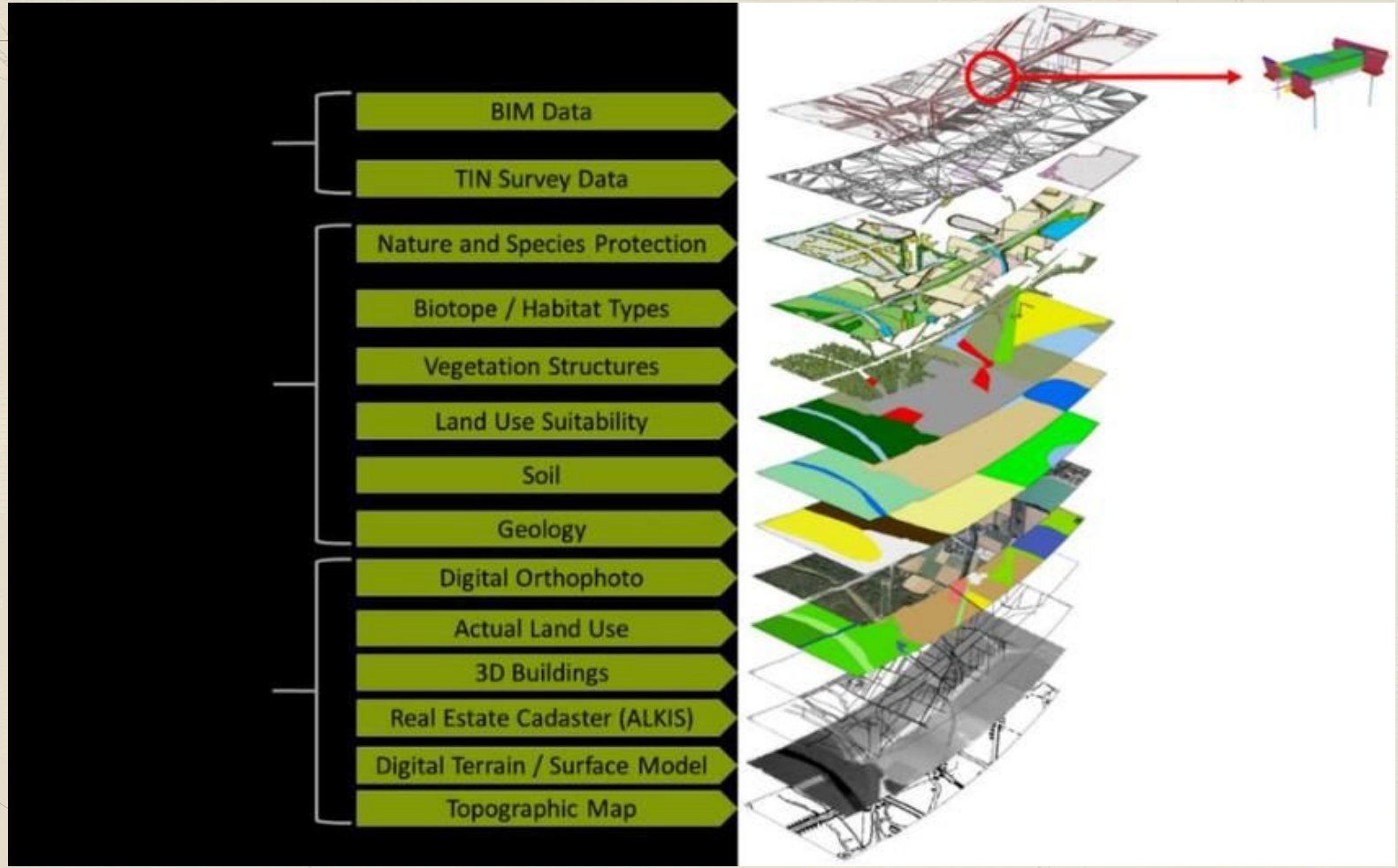
High speed rendering throughout data streaming and visualization

- Proper LOD level display from screen division
- Improving rendering speed throughout loading necessary data
- Multi-threading
- Efficient memory resource management

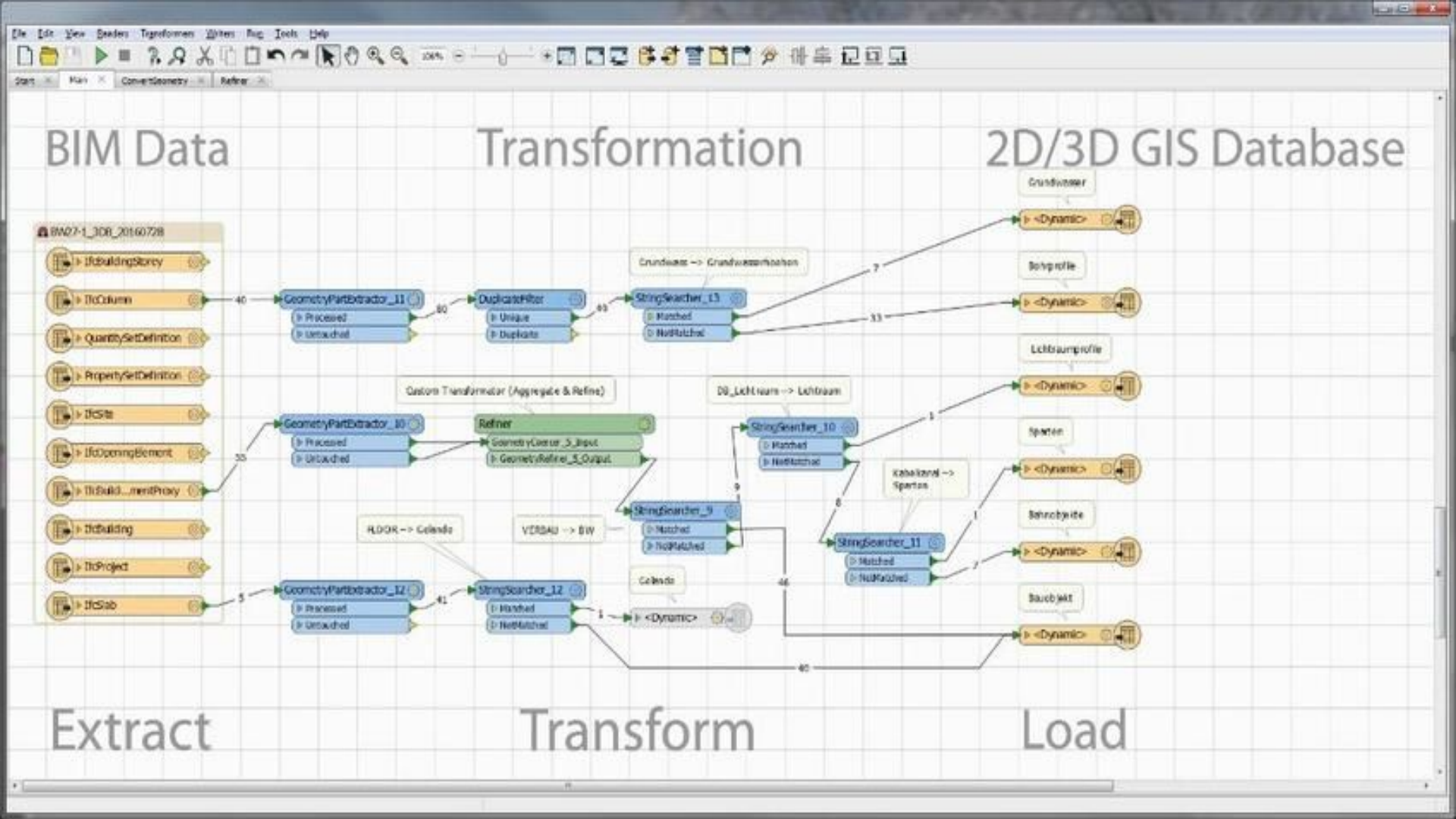




The integrated data exchange concept

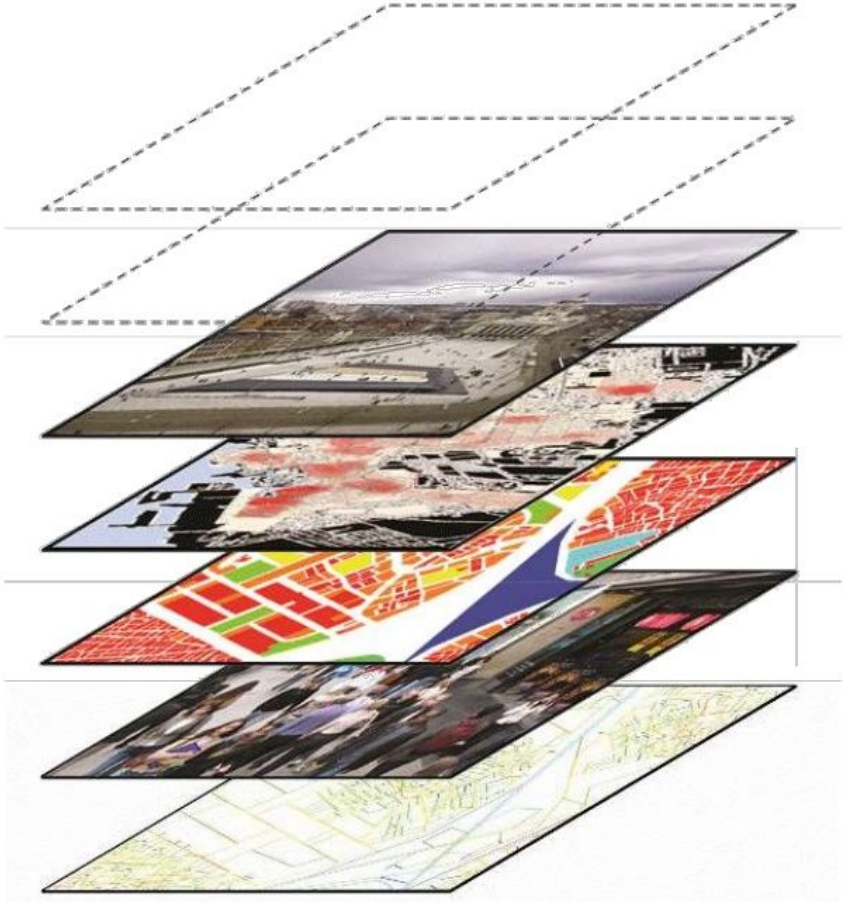


Integration of BIM data and GIS environmental planning data


BIM Data
Transformation
2D/3D GIS Database
Extract
Transform
Load
IfcBuildingStorey
IfcColumn
IfcSite
IfcOpeningElement
IfcProject
IfcSlab
GeometryPartExtractor_11
GeometryPartExtractor_10
GeometryPartExtractor_12
DuplicateFilter
Refiner
StringSearcher_13
StringSearcher_10
StringSearcher_9
StringSearcher_11
StringSearcher_12
Grundwasser
Bohrprofile
Lichtraumprofile
Sparten
Bahnkörper
Baugrubt
<Dynamic>

Integration of Autobahn A99 BIM data (circled bridge) into the 3D GIS and environmental planning data model

Integrated Urban Model

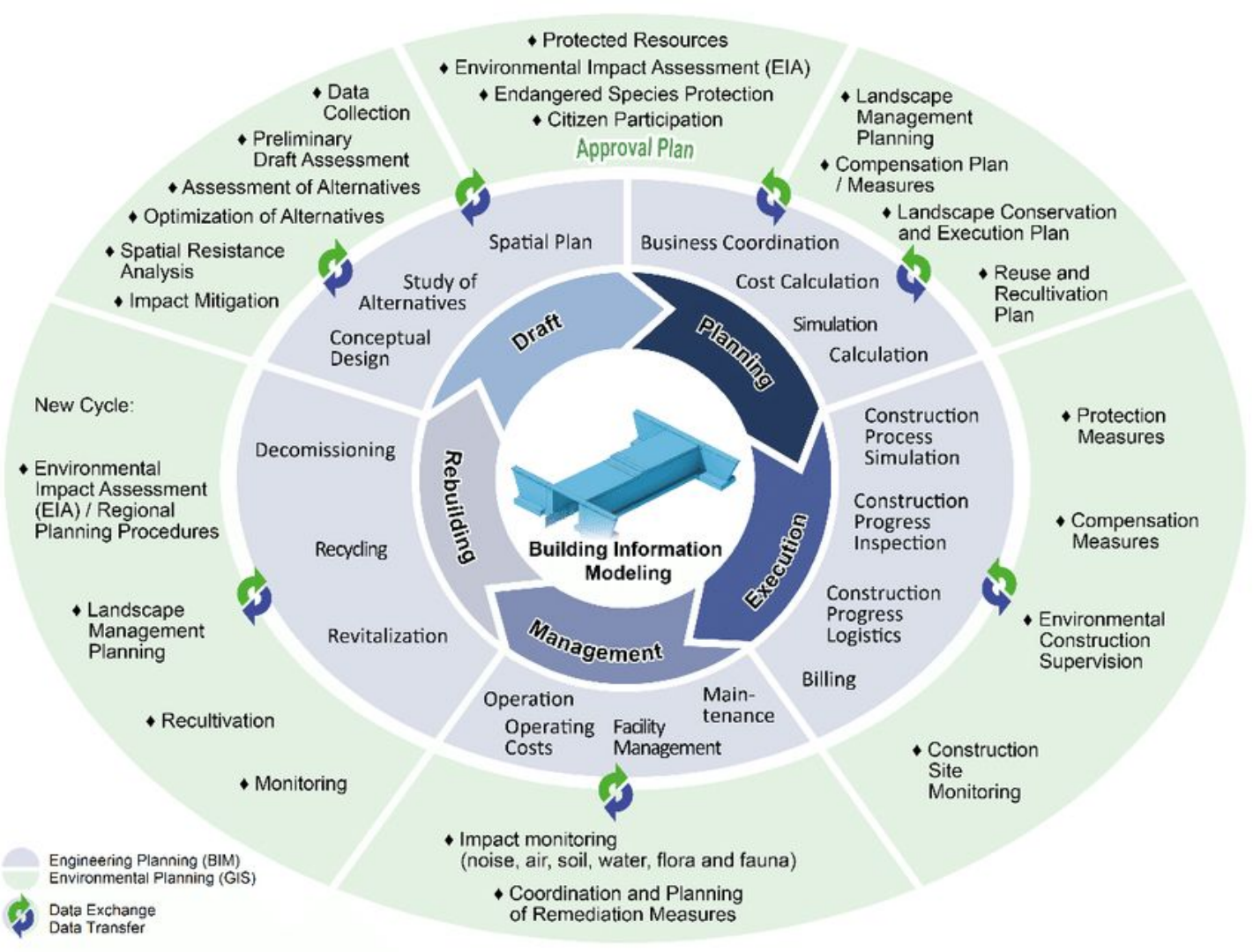


5. Carbon Emissions
4. Land Value
3. Crime & Safety
2. Land Use
1. Movement
0. Spatial Layout

Space Syntax © 2014

The big challenge is communication

- Between systems
- Between data formats
- Between organisations
- Between disciplines
- Between different roles

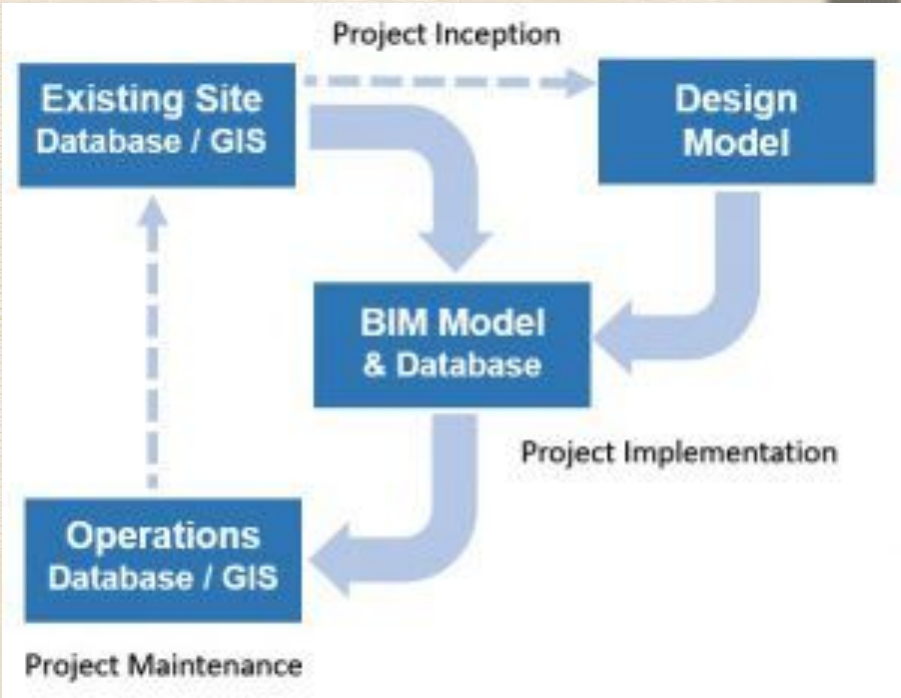

♦ Protected Resources
♦ Environmental Impact Assessment (EIA)
♦ Endangered Species Protection
♦ Citizen Participation
Approval Plan
♦ Data Collection
♦ Preliminary Draft Assessment
♦ Assessment of Alternatives
♦ Optimization of Alternatives
♦ Spatial Resistance Analysis
♦ Impact Mitigation
♦ Landscape Management Planning
♦ Compensation Plan / Measures
♦ Landscape Conservation and Execution Plan
♦ Reuse and Recultivation Plan
Spatial Plan
Business Coordination
Study of Alternatives
Cost Calculation
Conceptual Design
Simulation
Calculation
Draft
Planning
Rebuilding
Execution
Management
Building Information Modeling
New Cycle:
♦ Environmental Impact Assessment (EIA) / Regional Planning Procedures
♦ Landscape Management Planning
♦ Recultivation
♦ Monitoring
Decomissioning
Recycling
Revitalization
Construction Process Simulation
Construction Progress Inspection
Construction Progress Logistics
Billing
♦ Protection Measures
♦ Compensation Measures
♦ Environmental Construction Supervision
♦ Construction Site Monitoring
Operation
Operating Costs
Facility Management
Main-tenance
♦ Impact monitoring (noise, air, soil, water, flora and fauna)
♦ Coordination and Planning of Remediation Measures
Engineering Planning (BIM)
Environmental Planning (GIS)
Data Exchange
Data Transfer

Background

- Usage of GIS is still in growing state.
- Organisations are trying to conceptualise BIM and find ways to use this technology
- Coding in every details of a building (any type) + analysis is BIM.
- It needs very detailed attribute information in terms of design specifications, standards and rules well before the development of the asset.

Perceived value

- GIS and BIM are seen as technical tools for improve designs.
-



Why to Integrate

- To understand the need for integration lets run through a example.

Case:

A fast developing city selected to be host of a global sport event in 2022, geared up to spend US$75b in 12 years time. As part of the preparation host city wants to develop some part of city and create a world class living, business and entertainment

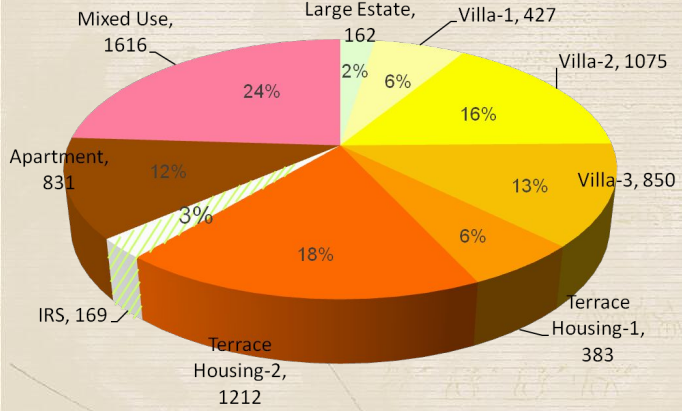
Full cycle sustainable development

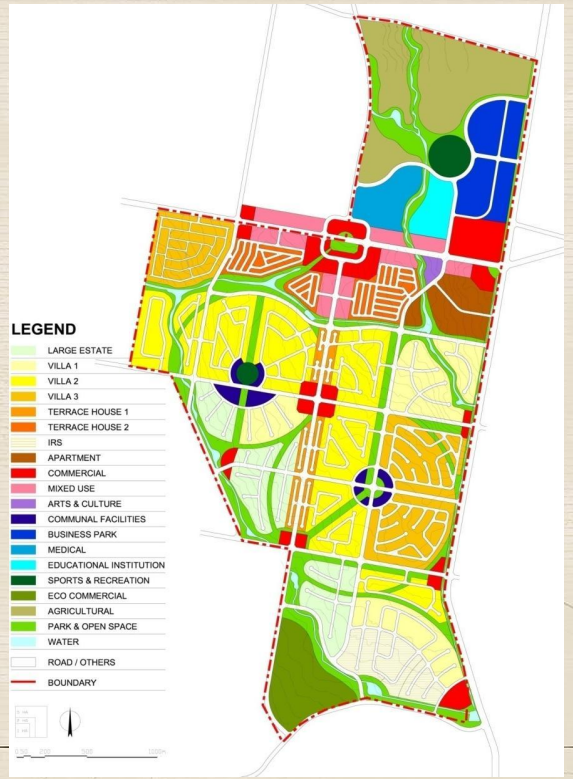
Scope of the project is to deliver design & develop a green field site of about 80 sq.km

- Urban design & Architecture
- Detailed Engineering
- Construction
- Maintenance

Land use plan & Zoning

DEVELOPMENT QUANTUM: DU

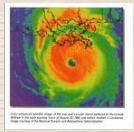




- Demand reduction
- On premise leaks & waste
- Discharge to sewers

Consume

Locate



- Recovery of treated water
- Hydrological modeling
- Weather modeling
- Water Rights

Deliver

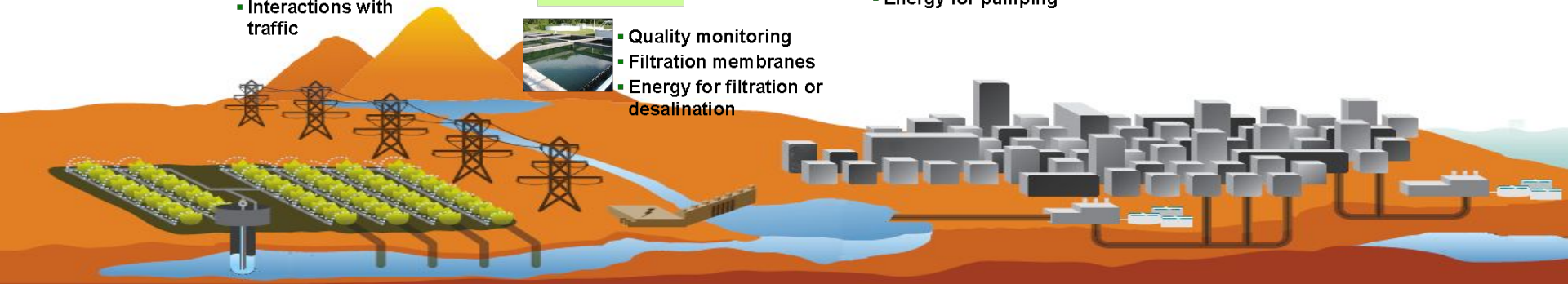
Capture and Store

- Asset management
- Flow management
- Leaks and overflows
- Interactions with traffic

Clean/ Desalinate

- Quality monitoring
- Weather modeling
- Energy for pumping

- Quality monitoring
- Filtration membranes
- Energy for filtration or desalination



Systems Effects and Resources Constraints

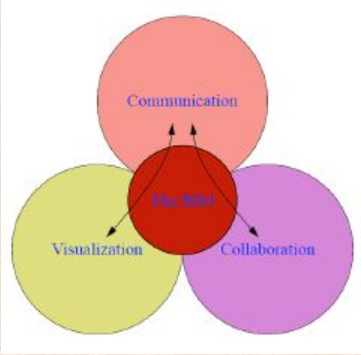
- “Slack” or excess capacity produces weak interactions
- Interactions become stronger when resources are constrained
- Under severe constraints – tipping points
- Examples:
  - Energy: MASDAR, Malta, Canary Wharf/London, Lower Manhattan….
  - Water: Middle East, US Western States, China (2030)
  - Transportation: Mexico City, Stockholm, China, India
  - Finance: <pretty much everywhere>
  - Economic Development: <pretty much everywhere>
- Conclusion: In the future, we need to take a systems view of the development and management of cities and regions

"The BIM is a tool which facilitates the flow of information and helps to create understanding and collaboration."

The three primary 'project enabling' principles are:

1. ***Visualization*** – the ability to form a picture in our head based on understanding information.
2. ***Communication*** – the transfer of information which leads to understanding.
3. ***Collaboration*** – the mutual support which leads to common understanding and positive action.

Communication connects Visualization to Collaboration.



"Creating the BIM is an action which will generate more understanding of the project particulars than any other activity related to the design and construction process."

"A BIM is as good as the (both project and process) understanding of the team which creates it."

Outline for a BIM Curriculum.

By Willem Kymmell, architect
Assoc. Prof. Construction Management
Founding partner - Construction Simulation Lab
CSU Chico, Chico, CA
wkymmell@csuchico.edu

Pre-Design

- As-Built Documentation
- Program development/ Feasibility

Concept Design

- Validate: program, circulation, egress, energy, urban, preservation, cost

Design Development / Const. Doc

- Production, coordination
- Mockup
- Phasing

Construction

- collision detection
- construction sequencing
- shop drawing, fabrication
- construction tolerance

Commissioning / Operation

- as-built documentation
- system conditioning and reporting
- spatial data management

BIM Levels of Information

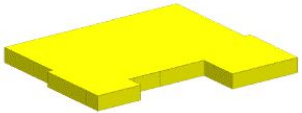
Stepped Strategy of Data Collection and Modeling

Minimal level of data modeling necessary to integrate BIMs with other data?

Surprising little is needed to get the highest value from the BIMs.

Value comes over time in a logical stepped sequence of data collection.

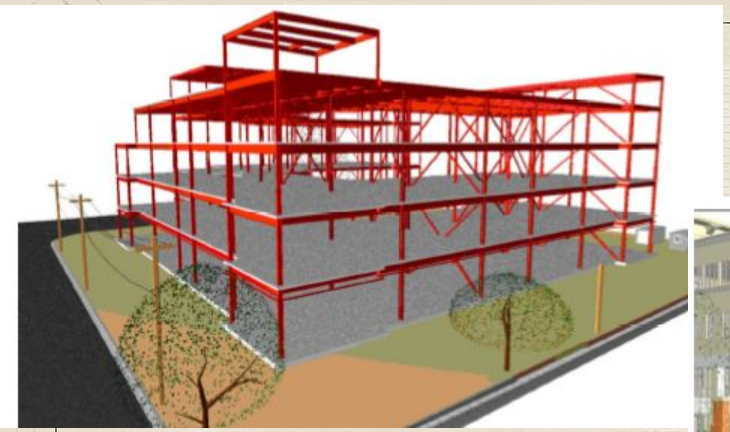
Simple Mass Defining Total Square Footage 16,900 SF

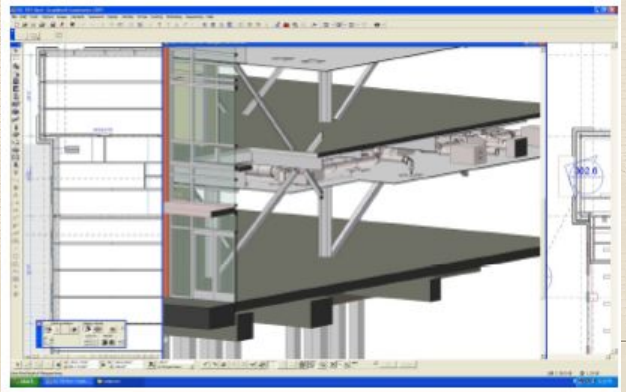


Mass With Rough Outline Defining Total Square Footage 16,900 SF

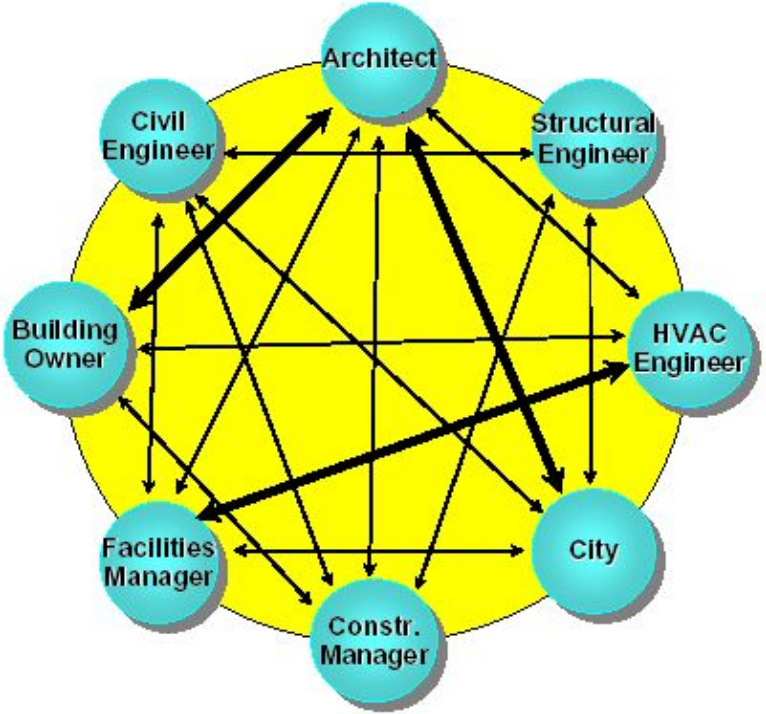
Mass Accurate Outline Defining Total Square Footage 16,900 SF

All of the levels can reference data that exists in other levels of detail.





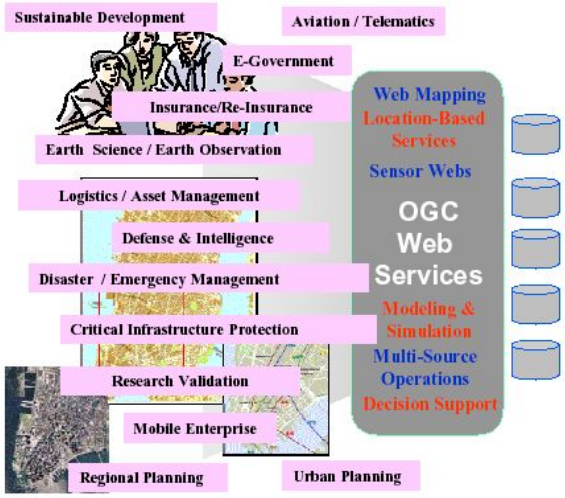
Traditional Information Exchange



buildingSMART Information Exchange

Pushing the Standards Edge:
Collaborative Testbeds to Accelerate Standards Development and Implementation

What Drives OGC Standards Development?



Tackling major interoperability challenges of next-generation data / service sharing and collaboration….

Developing new specifications for location-based services interoperability and spatially enabling the systems and enterprises

Working across standards consortia to accomplish mission objectives

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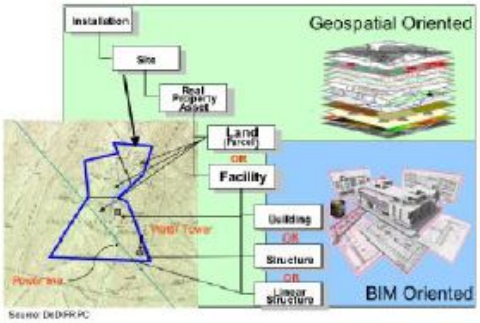
OWS-4 CAD / GIS BIM Integration
BIM In Context for Project Development

AEC Projects will benefit by integrating BIM in geospatial context throughout project lifecycle:

- Initial ground condition from OGC Standards Based systems will aid in initial site planning
- Existing and surrounding site buildings may be delivered as CityGML, an XML encoding based on OGC's Geography Markup Language
- Detailed engineering connections and conflicts may be understood and modeled by integration of BIMs of neighboring sites



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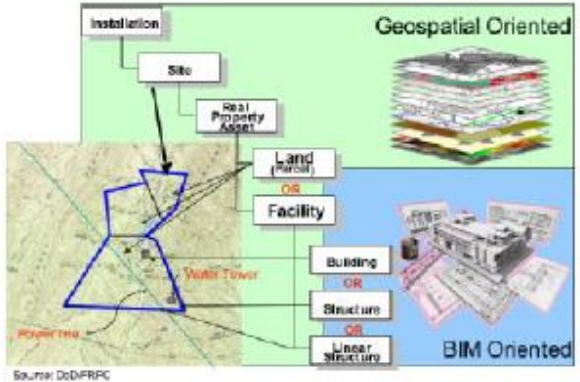
OWS-4 CAD / GIS BIM Integration
BIM In Context for Project Development

Broad-scale assessment will be facilitated by integration of information aggregated from multiple BIMs:

- Space Planning
- Facilities Management / Security
- Build-Out Analysis
- Emergency Planning/Management
- Detailed, 4-D Virtual City Application



Source: DoD/FRPC

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CAD / Geospatial / 3D Integration

Open Standards approach to sharing of information and services between AEC / CAD and geospatial technologies

Critical for Urban Planning, Emergency Response, Homeland Security, Defense and Intelligence, site planning, Maintenance, Engineering…

OGC®

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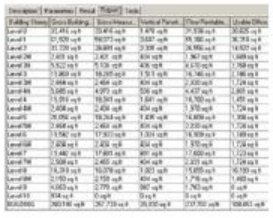
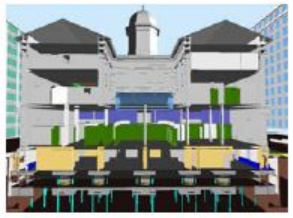
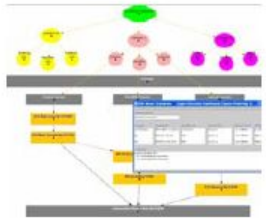
GSA

General Services Administration

Public Buildings Service







Images from GSA Pilot Project applications of 3D, 4D, and BIM technologies

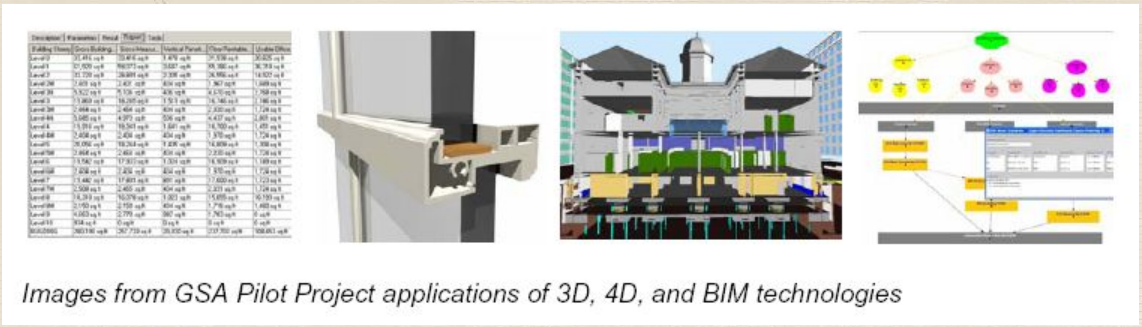
GSA's mission is to "help federal agencies better serve the public by offering, at best value, superior workplaces, expert solutions, acquisition services and management policies."

- Increased Security Requirements
- Rising Energy Costs
- Cost of Construction Materials
- Changing Customer Requirements

Challenges Facing the Organization

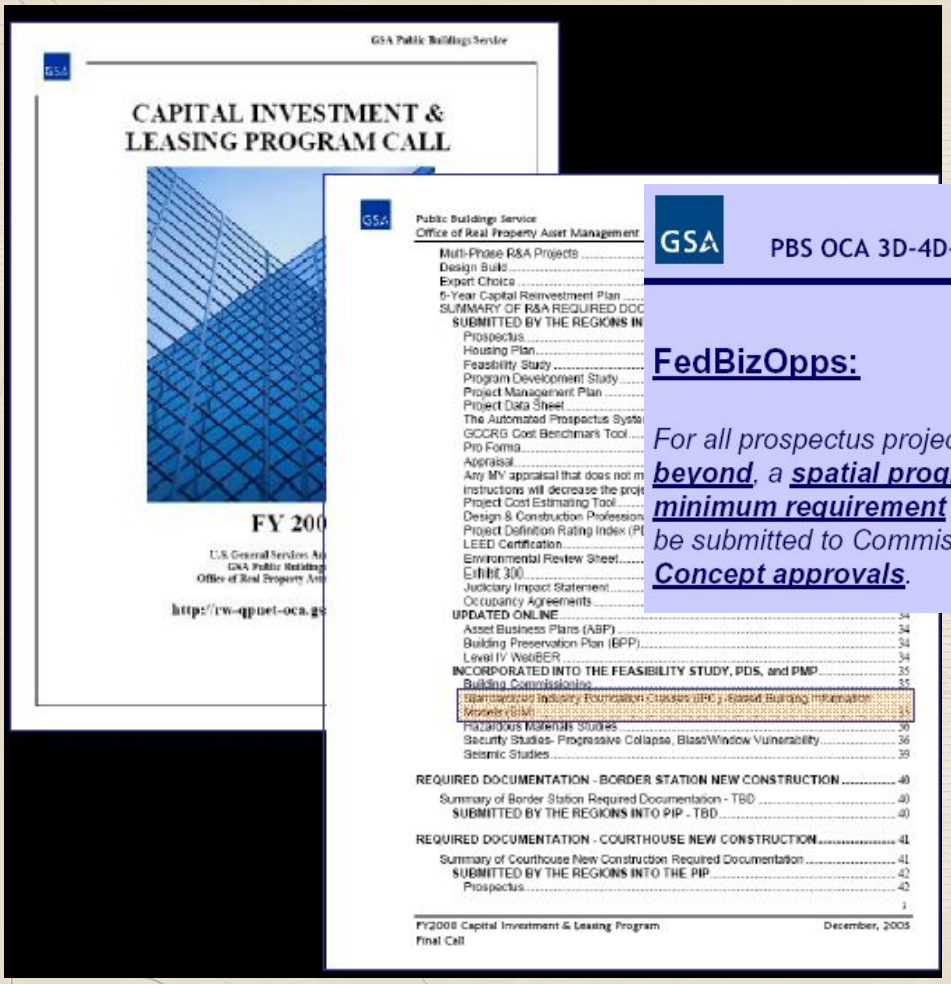
- Helps Customers Make Informed, Rational Security Decisions
- ID Security Gaps
- Aligns with Interagency Security Committee Design Criteria

- Plan & Mitigate Risk
- Identify Gaps in the Design Phase
- Identify Whether Designs Meet Specific Objectives and Criteria
- Identify Problems with the Project Budget
- Communication Tool for Customers



Images from GSA Pilot Project applications of 3D, 4D, and BIM technologies

- US General Services Administration (GSA),
- ‘virtual building models’
- use and deliver **digital datasets** for facility operations, maintenance and renewal;
- support improved service delivery, enhanced emergency planning, management and response.



GSA

PBS OCA 3D-4D-BIM Program

FedBizOpps:

*For all prospectus projects receiving design funding in **FY2007 and beyond**, a **spatial program** Building Information Model will be the **minimum requirement** for all new and modernization projects that will be submitted to Commissioner of the Public Buildings Service for **Final Concept approvals**.*

Creating a Standard for BIM

- The NBIMS Project Committee seeks to facilitate integration by providing a
  - common **language for describing facility information**
  - common **views of information** based on the needs of businesses engaged in all aspects of facility commerce
  - common **standards for sharing data** between businesses and their data processing applications.
- expected to significantly reduce

- International standards organizations include the
- National Building Information Model Standard (NBIMS), National Institute of Building Standards (NIBS)
- Open Standards Consortium for Real Estate (OSCRE),
- Open Geospatial Consortium, Inc. (OGC®),
- International Alliance for Interoperability (IAI) International, and
- FIATECH – an industry consortium formed to identify and accelerate the development, demonstration and deployment of fully integrated and automated technologies.
- American Institute of Architects (AIA),
- Building Owners & Managers Association (BOMA),
- Construction Specifications Institute (CSI),
- Construction Users Roundtable (CURT),
- International Facilitates Management Association (IFMA),
- Mortgage Bankers Association, etc.

For information to be useful it must adhere to open standards.

- The beneficiaries of BIM include
  - owners, planners, realtors, appraisers, mortgage bankers, designers, engineers, prototypers, estimators, specifies, safety, occupational health, environmentalists, contractors, lawyers, contract officers, sub-contractors, fabricators, code officials, operators, risk management, renovators, first responders and demolition.
- Each has their own view of the information, many share the same information but some have unique uses.

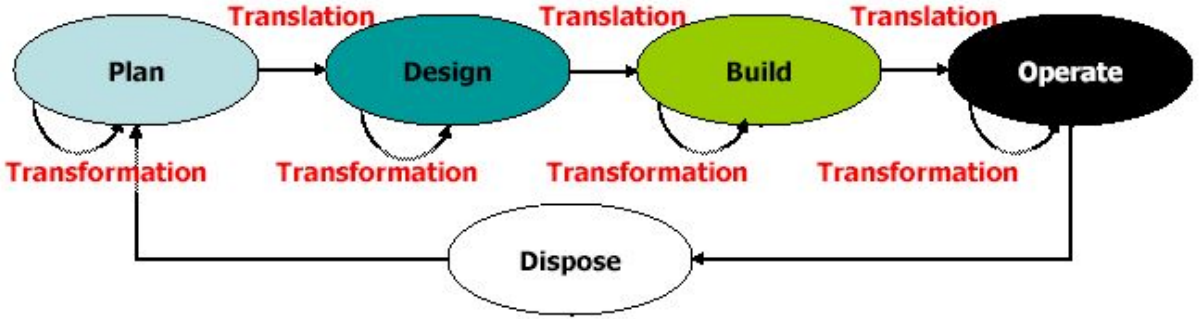
Problem – Building Design is Fragmented

- architects design, constructors construct, and building managers manage in isolation.

- Architects, Engineers and Construction Contractors each submit design plans,
- operating instructions and repair manuals in hardcopy
- which must be organized and maintained in order to support building operations, maintenance and renovation throughout the building's life
- The vision is to reengineer the fragmented building industry to seamlessly integrate all building project phases within a BIM

Various documents share same information structures , however, information generated in each document cannot directly be transferred to another application or cross-referenced

Problem - Critical data is lost …



- decisions made as ideas & parts are **transformed** into designs & buildings are not captured
- **translation** of information for downstream use looses much of what is known during the previous phase

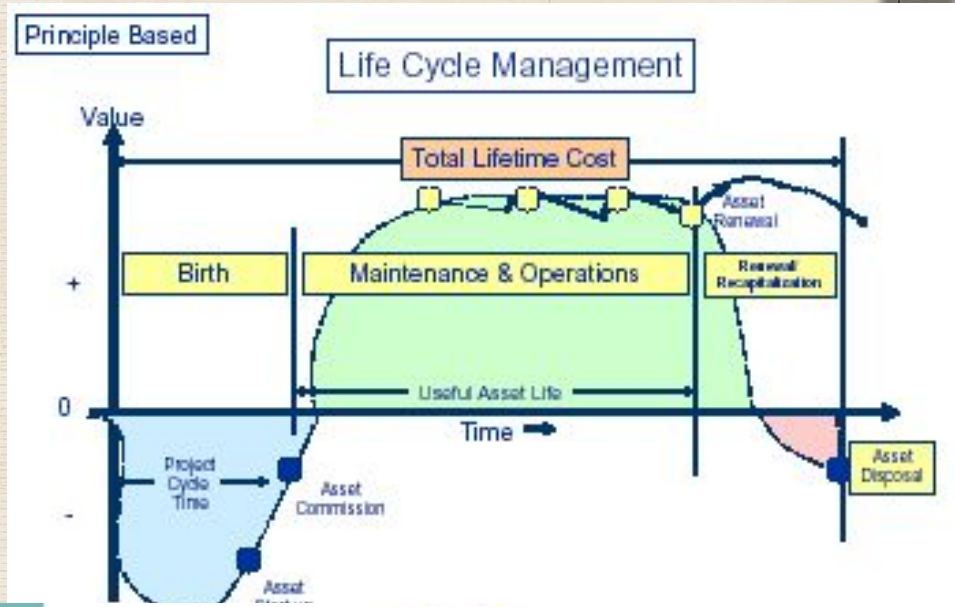
NIST Study on Cost of Inadequate Interoperability

- 2004 NIST study (U.S. Department of Commerce, National Institute of Standards and Technology, “Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry”, (NIST GCR

Interoperability is the ability to share and manage information between project stakeholders.

- Currently, BIM is envisioned as an approach to **data integration (interoperability),** a central repository of continuously available up-to-date integrated information on building design, construction, and management.
- However, for BIM to be effective and replicable, agreement on the concepts must be achieved and codified within suitable computable technologies that are organic and adaptable to changing circumstances.

BIM is intended to be a open standards based repository of information for the facility owner/operator to use and maintain throughout the life-cycle of a facility.



ASSET EVOLUTION

© Asset Evolution 2006

T.E.A.M.S. Total Enterprise Asset Management Solution TM

Engineering, Construction, and Facilities Asset Management: A Cultural Revolution

National Institute of
Building Sciences

National Building Information Model Standard

Based on and supporting buildingSMART International Alliance for Interoperability Industry Foundation Classes Information Delivery Manuals and International Framework for Dictionaries

BIM: Pushing Standards To The Edge

National Building Information Model Standard

Deke Smith, RA
Chair, NIBS National BIM Standard Project Committee

Federal Facilities Council

October 31, 2006

This presentation is a collaborative product of the NIBS NBIMS Project Committee.

National Building Information Model Standard

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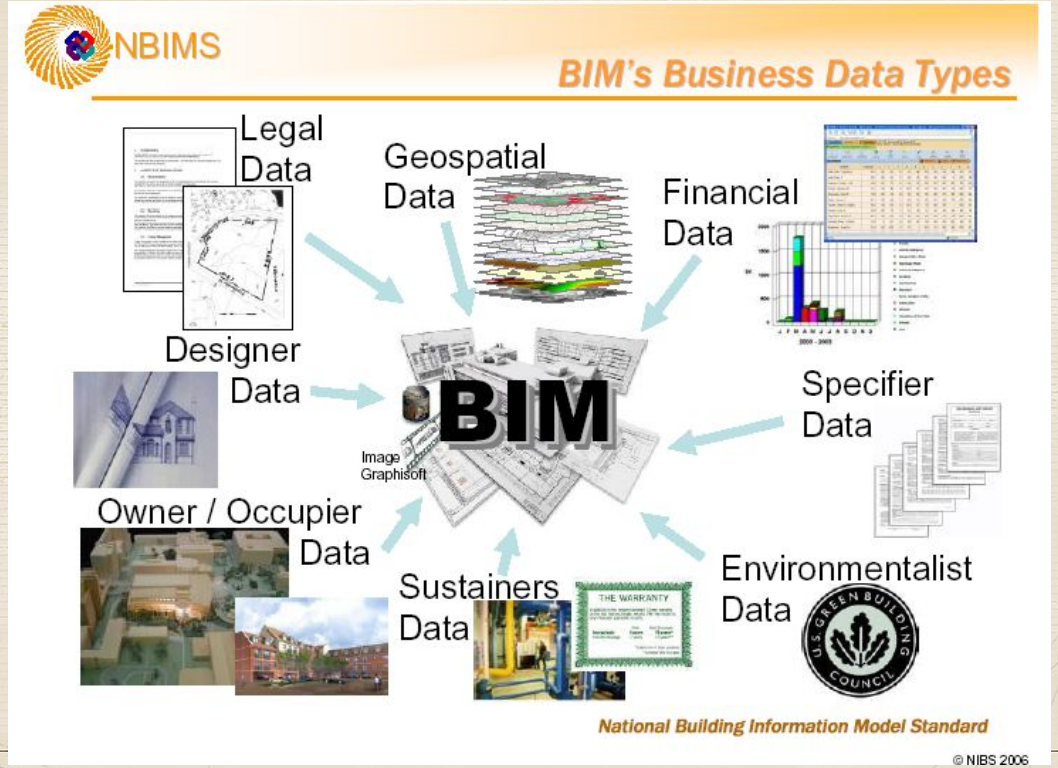
Define expansive scope of BIM

- Everyone starting from different points of view
- Breaking down stovepipes
- Developing awareness and appreciation of life-cycle approach



NBIMS

BIM Enabled Construction Industry

Facility Information Views

- Owners
- Planners
- Realtors
- Appraisers
- Mortgage Bankers
- Designers
- Engineers
- Cost & Quantity Estimators
- Specifiers
- Contracts & Lawyers
- Construction Contractors
- Sub-Contractors
- Fabricators
- Code Officials
- Facility Managers
- Maintenance & Sustainment
- Renovation & Restoration
- Disposal & Recycling
- Scoping, Testing, Simulation
- Safety & Occupational Health
- Environmental & NEPA
- Plant Operations
- Energy, LEED
- Space & Security
- Network Managers
- CIO's
- Risk Management
- Occupant Support
- First Responders

National Building Information Model Standard

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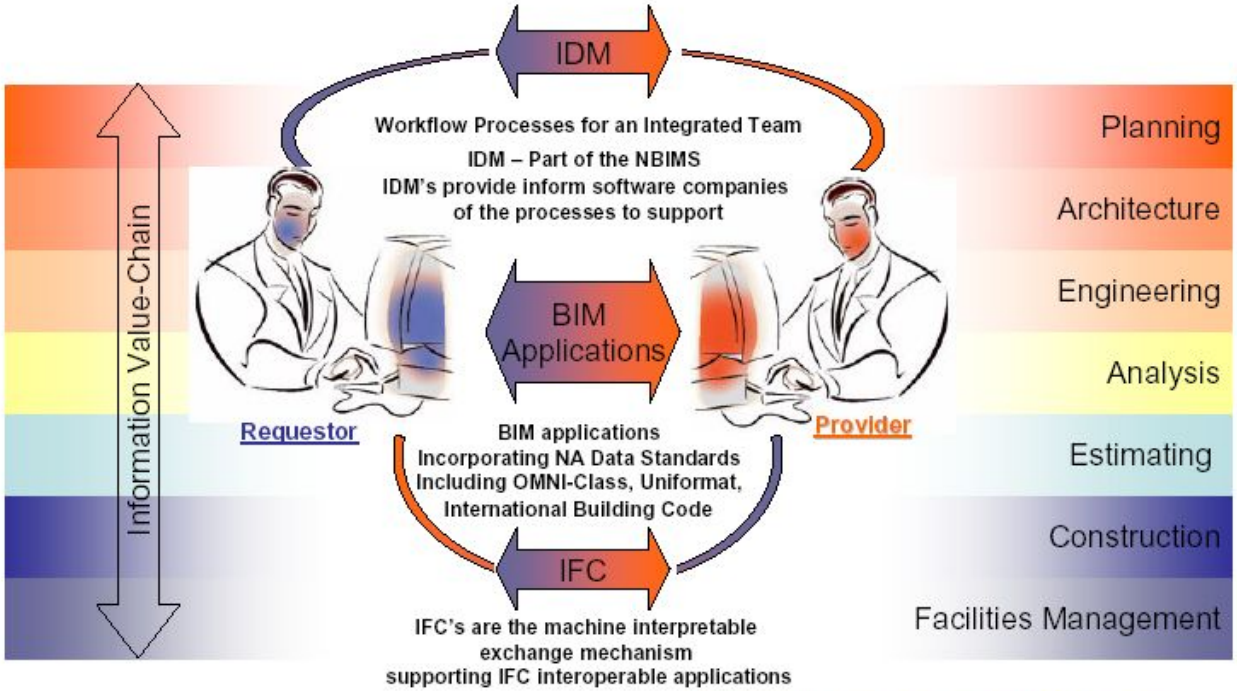
NBIMS

Developing the BIM Value-Chain



National Building Information Model Standard

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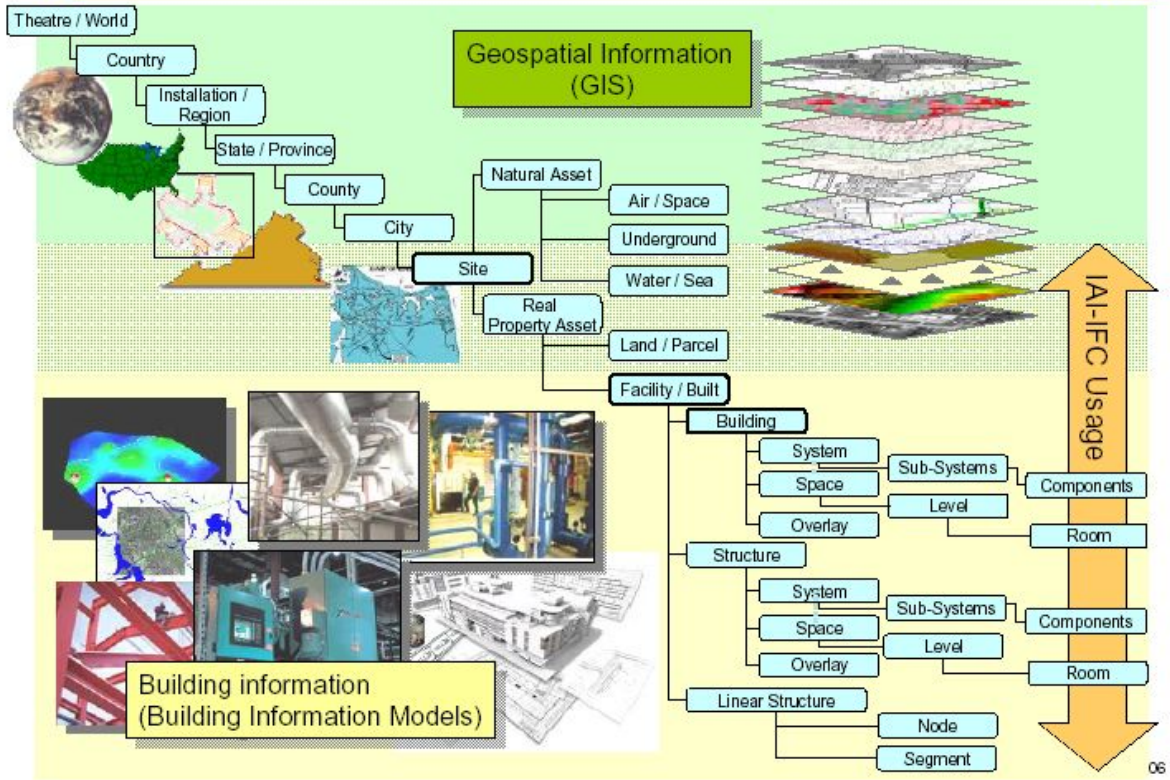
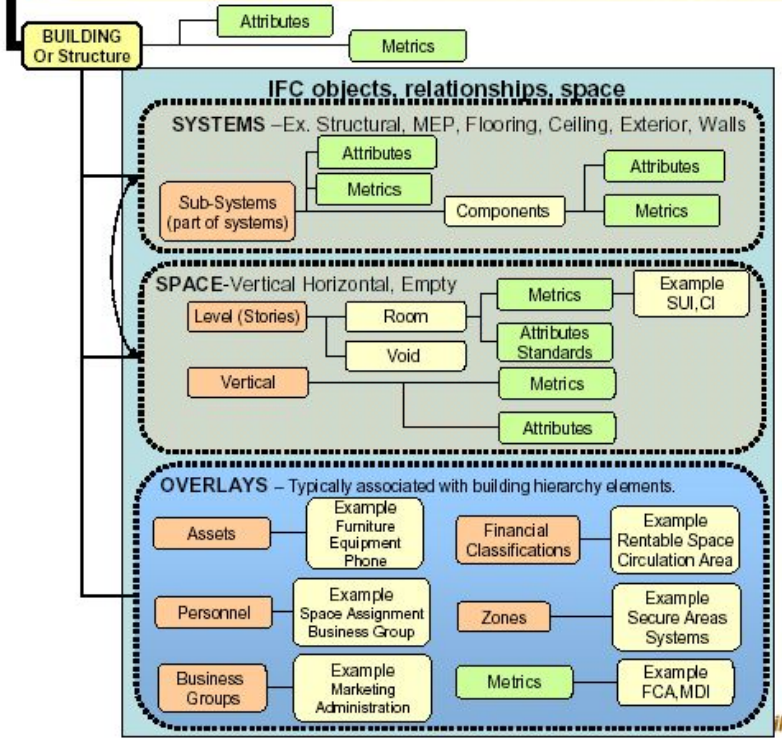
NBIMS

Hierarchical Information Relationships



NBIMS

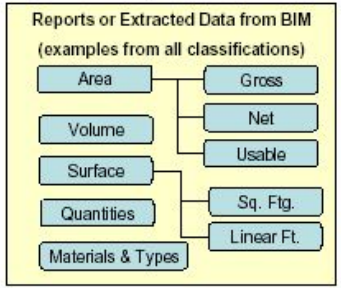
Hierarchical Building Information Relationships



Systems represent the physical entities of the building. Systems use NA classifications such as Omni-Class and Uniformat and are transported/exchanged via IFCs

Space is physical in nature, but can be unbounded (have no or cross physical boundaries) but it will always be tied to the physical structure or systems in some way

Overlays are more abstract data - organizational, operational, functional, financial, non-fixed assets, resources, personnel, etc. that is data tied to the Systems and Space



lding Information Model Standard

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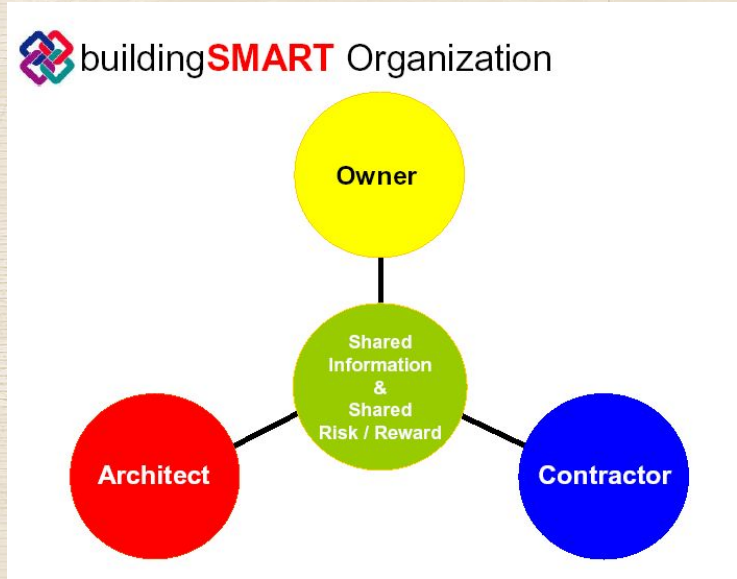
buildingSMART
International Alliance for Interoperability

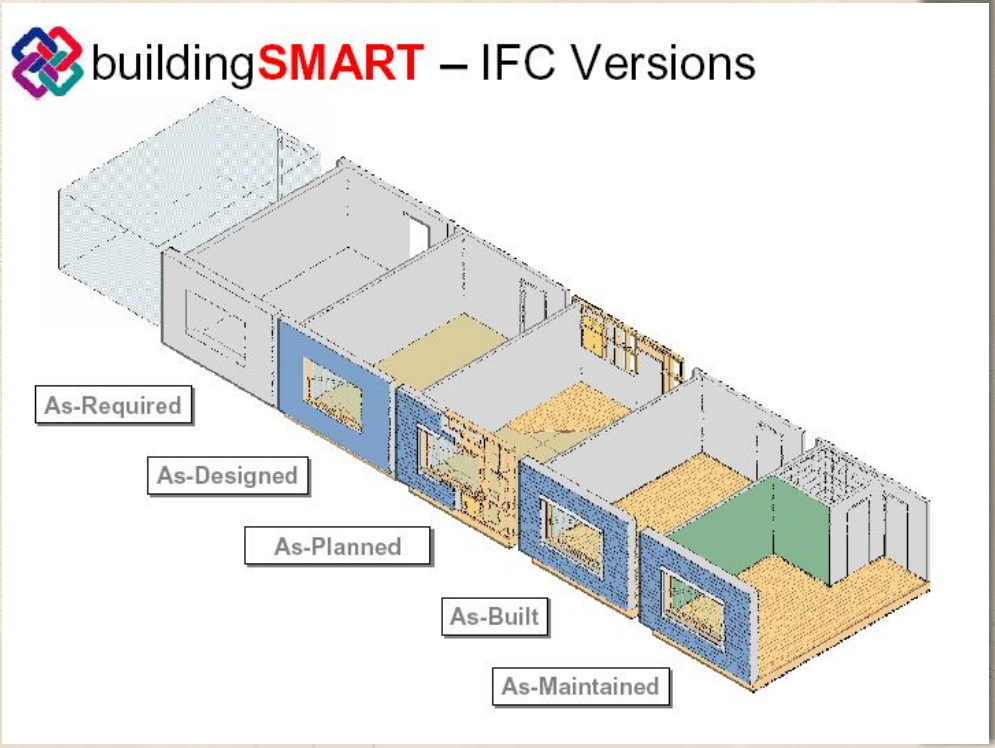
- Patrick MacLeamy, FAIA
- CEO, HOK
- International Chairman, IAI

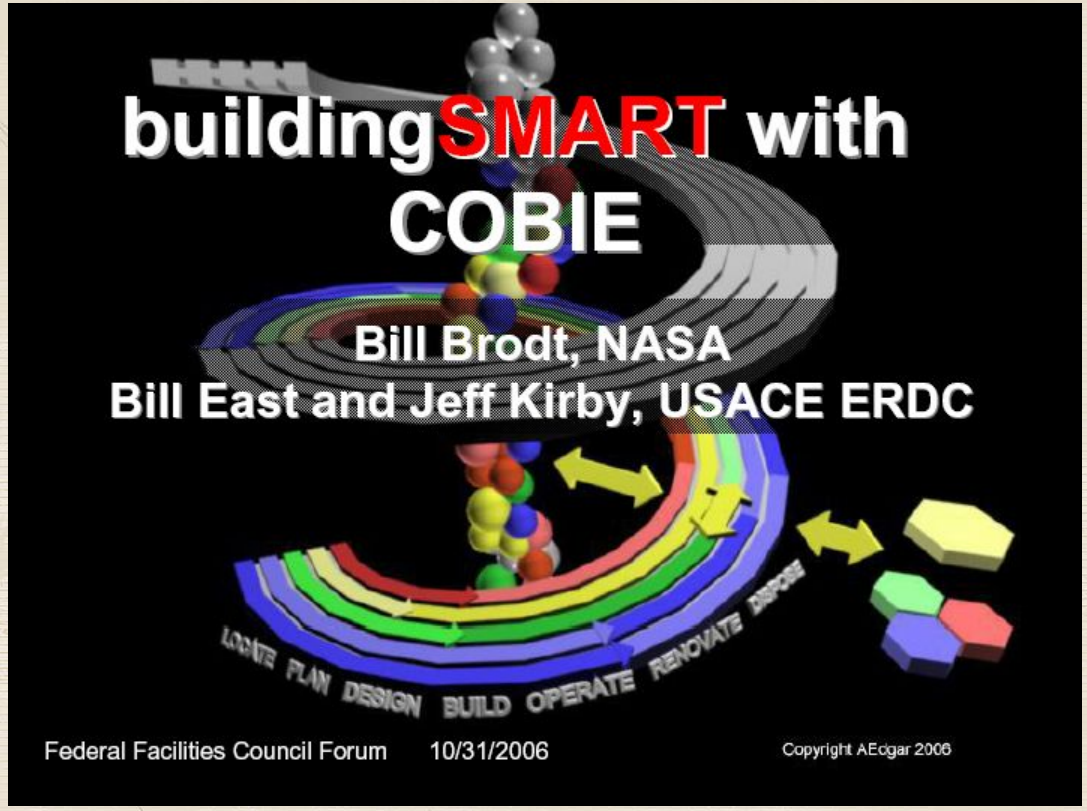


buildingSMART organization

buildingSMART design

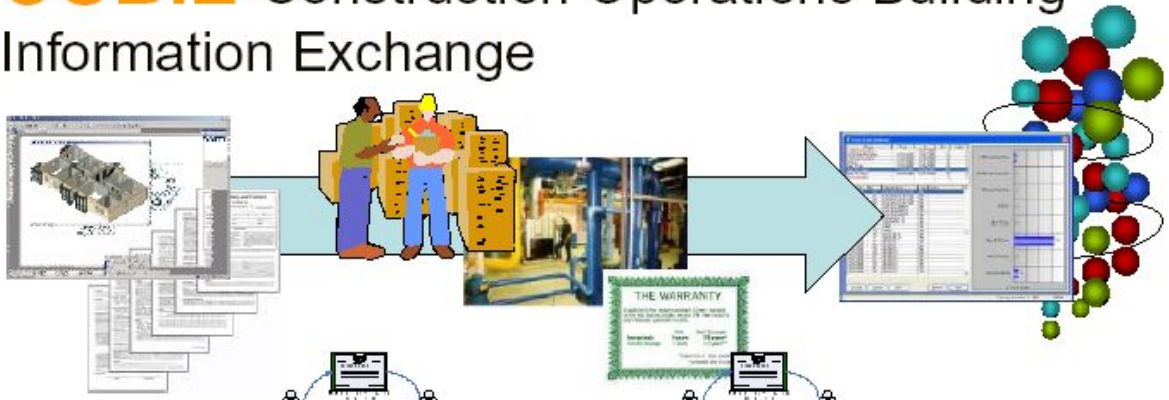
buildingSMART information exchange


buildingSMART – IFC Versions
As-Required
As-Designed
As-Planned
As-Built
As-Maintained


buildingSMART with COBIE
Bill Brodt, NASA
Bill East and Jeff Kirby, USACE ERDC
LOCATE PLAN DESIGN BUILD OPERATE RENOVATE DISPOSE
Federal Facilities Council Forum 10/31/2006
Copyright AEcgar 2006

COBIE Overview Briefing:
http://nbims.opengeospatial.org/files/?artifact_id=352

COBIE Construction Operations Building Information Exchange



Conception & Definition Phases
Identify items from the specifications that will require warranty information

Procurement & Execution Phases
Collect information as items are ordered and delivered such as who is warranting, when the warranty starts, how long is the warranty period, what preventive maintenance is required to keep the warranty in force

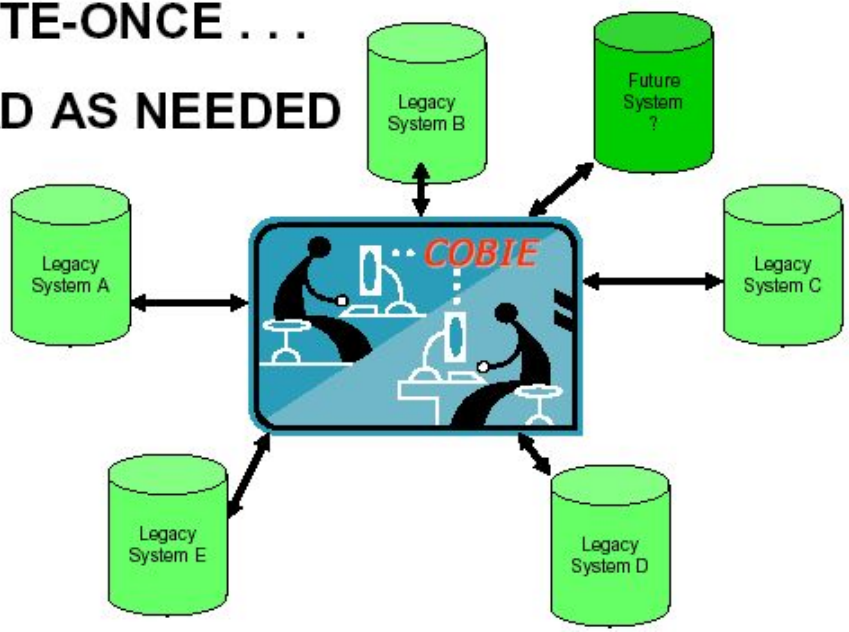
Utilization & Closure Phases
Read the information collected directly into your CMMS software to ensure that the warranties are supported

COBIE will demonstrate the flow of information through the phases of a facility something that is not yet happening yet Is critical to realize the total potential ROI

COBIE uses internationally recognized standard and data definitions requirements . . .

WRITE-ONCE . . .

READ AS NEEDED



WBDG
WHOLE BUILDING DESIGN GUIDE
HOME | ABOUT WBDG | SITE MAP | SEARCH SITE
News, Events & Training
Design Guidance
Project Management
Mandates / References
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Key Features Include:
Reduces time needed to identify products that comply with federal guide specs
Displays product information in an easy to understand format
Provides product information directly to those with a need to know
Explore Product Guide
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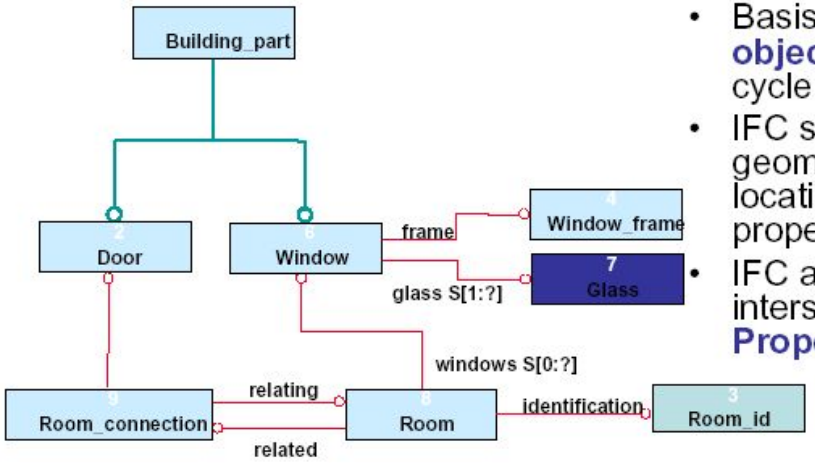
If you have suggestions or want to comment on this website, please contact us.

Technical Data

- PDF format
- link to URL
- or XML database

- The classes defined by the IAI are termed Industry Foundation Classes (IFCs) for the following reasons:
- IFCs are defined by the AEC/FM **industry**. These specifications represent a data structure supporting an electronic project model useful in sharing data across applications.
- They provide a **foundation** for the shared project model
- They specify **classes** of things in an agreed-upon manner that enables the development of a common language for construction.
  - specify how "things" that could occur in a constructed facility should be represented electronically.
  - The word "class" describes a range of things with common characteristics. For instance, every door has the characteristics of opening to allow entry to a space
    - Class describes real things such as doors, walls, and fans as well as abstract concepts such as space, organization, information exchange, and

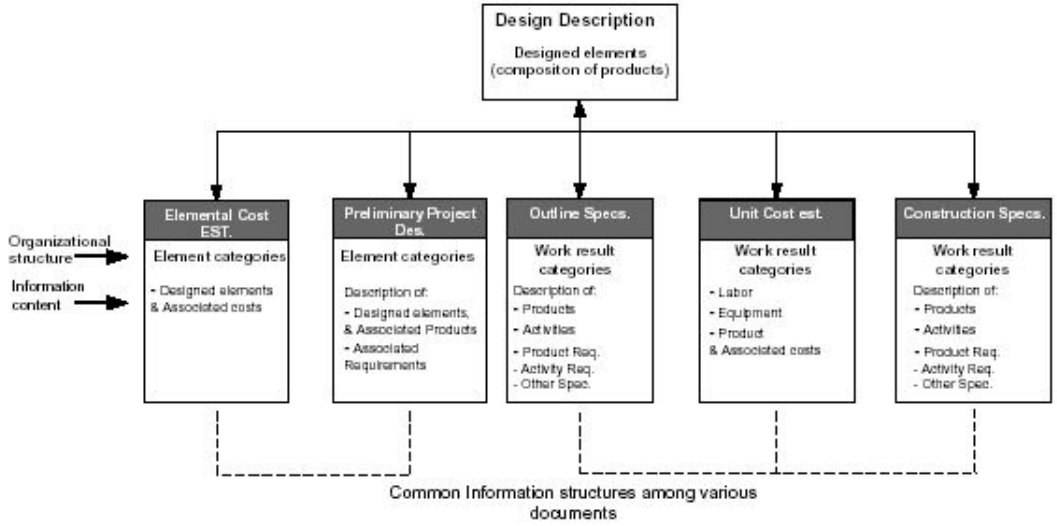
Industry Foundation Classes



- Set of internationally standardized **construction industry object definitions**
- Basis – **integration of objects** across project life cycle using a single model
- IFC stores **object data** – geometry, 3D dimensions, location, relationships, properties
- IFC and *OmniClass* intersect in **Elements** and **Properties Table**

International Open Standard = IFC model

CSI Formats and **B**uilding **I**nformation **M**odeling

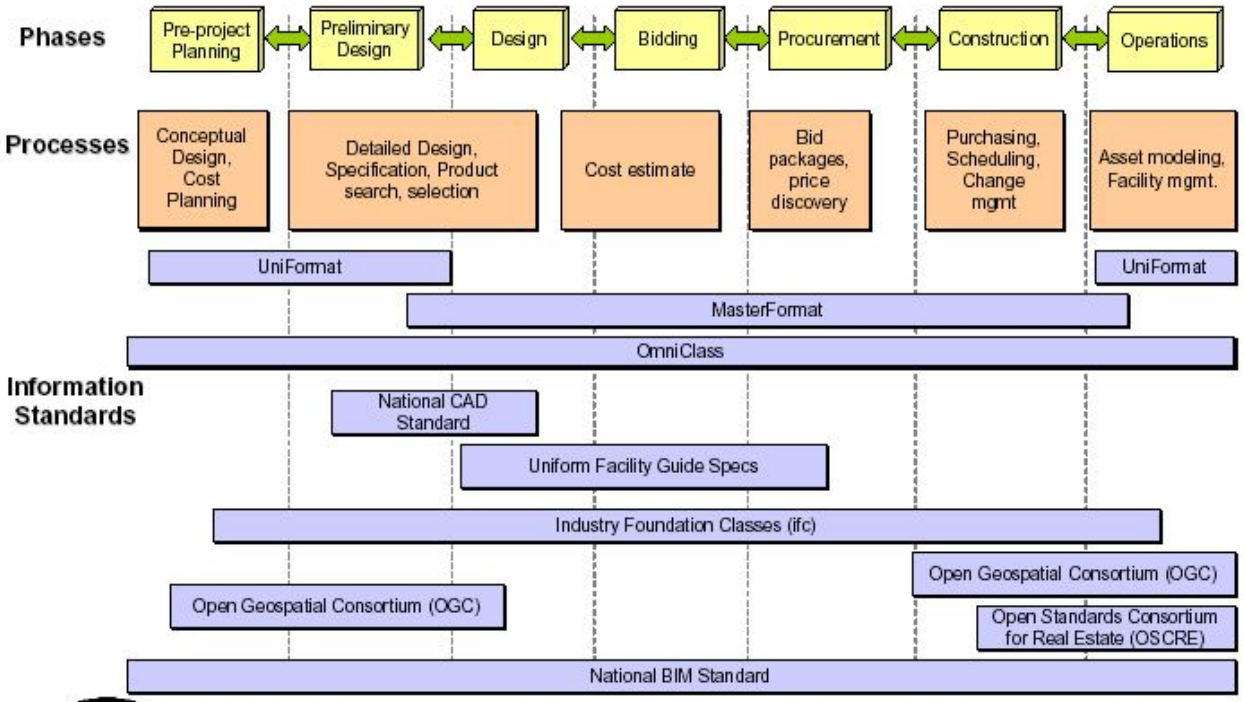


Roger J Grant
Director Technical Services and Development,
The Construction Specifications Institute

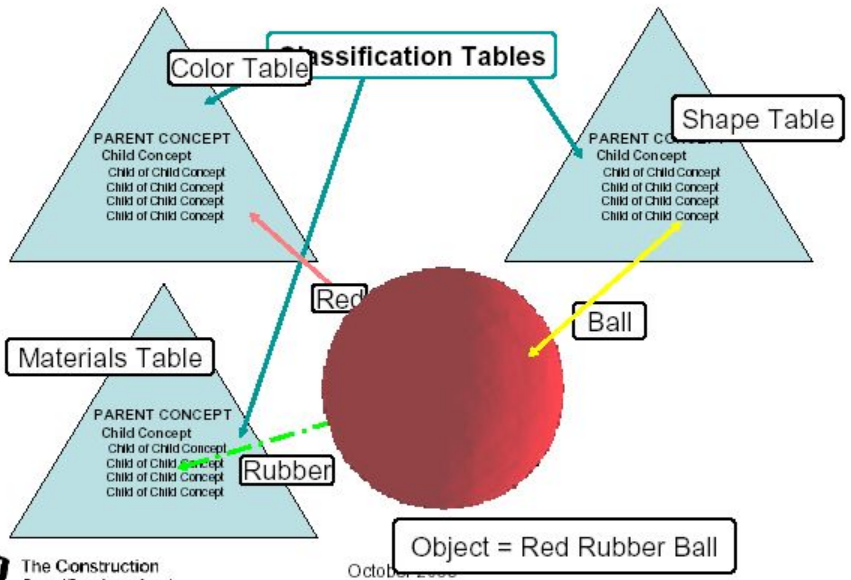
The Construction Specifications Institute

buildingSMART™ International Alliance for Interoperability NORTH AMERICA

North American Information Standards

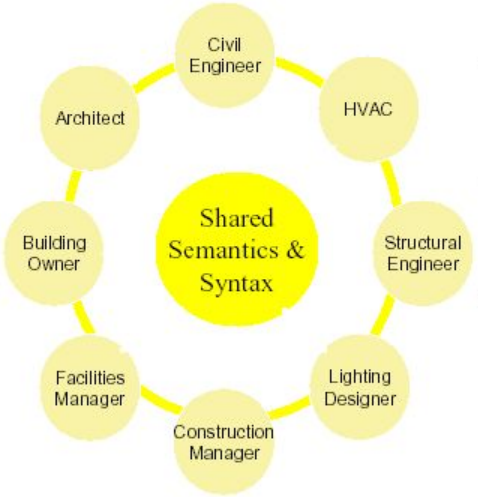


Faceted Classification



Bi-directional Information Flow and Cross-referencing

Agree on Semantics and Syntax



- *Participants can communicate using a common language*
- *Any participant can communicate with any other participant*
- *Facilitates high performance teams*

Info-Centric Organization

Framework for Integrated Decision-Making

Essence of this *IT-Enabled* Enterprise Framework:

- Moving away from building-centric and project focus
- Moving to a portfolio-based, business process linked to strategic outcomes
- Continuous horizontal flow across the organization
- Break down of the traditional structure of professional and trade disciplines and traditional stove piped software development

Capital Asset Management Portal

Access to Aggregated Database and Graphics

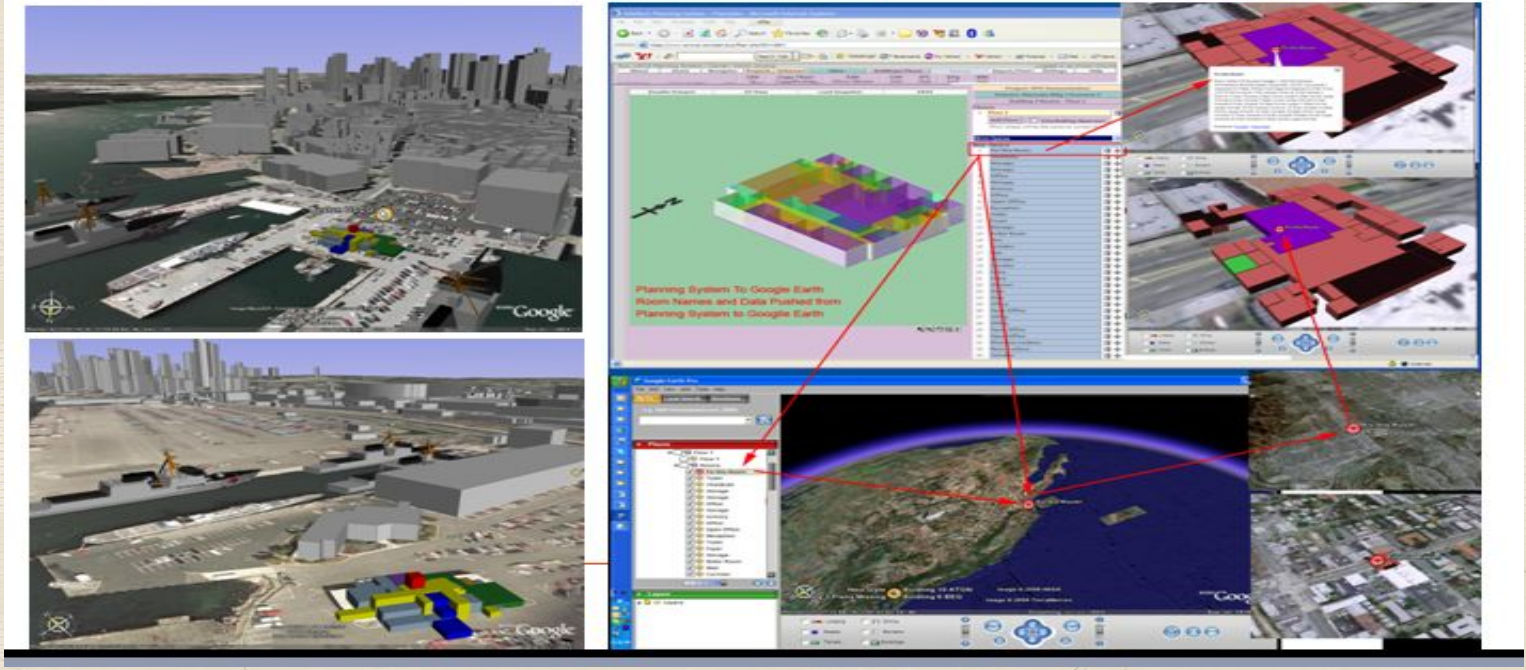
CAMP combines and displays portal tools and data views supporting Portfolio Management and Integrated Decision-Making and Value Chain.

- Portfolio Management Links Supply and Demand Side of Scenario Based Mission Planning:

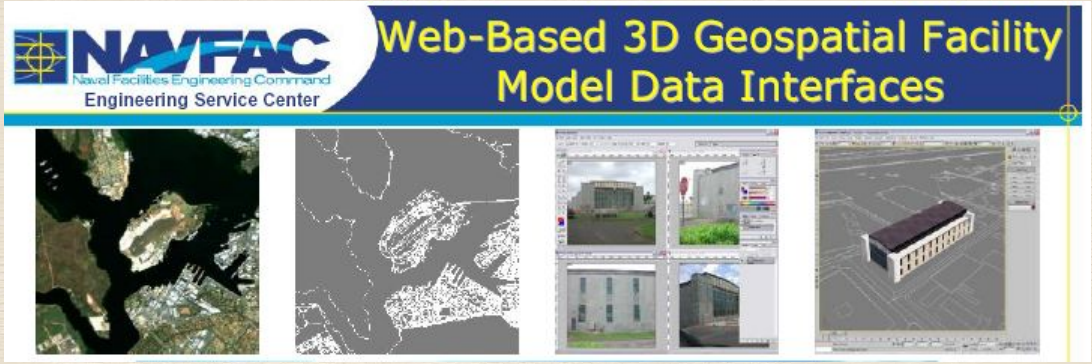
- Real Time Mission Readiness
- Scenario Based Business Case Development
- Automated Planning Documentation and Web-enabled Approval Process
- Value Chain as Web-enabled Workflow

Combined BIM and GIS Workflows

Multiple Data Sources Accessed through CAMP



Blind Grading Experiences

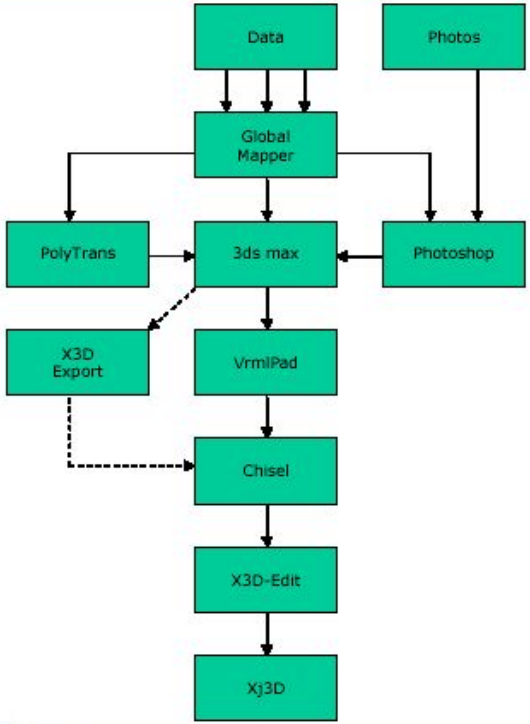


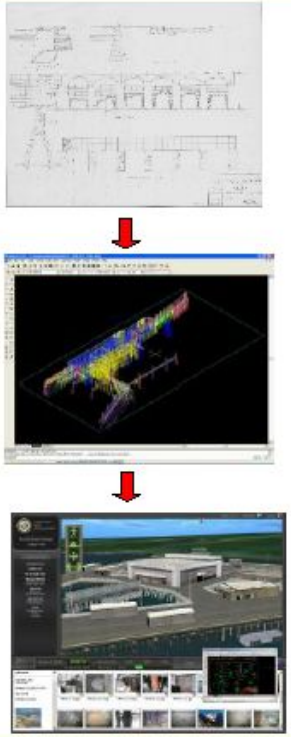
Alex Viana
Naval Facilities Engineering Command
Washington Navy Yard, DC

This presentation describes a step by step processes utilized to produce virtual 3D waterfront facility models of the Navy's built environment from paper drawings, existing 2D CAD files, and other geospatial data sets. The facility models have been created in open source, ISO-based standards format for 3D web graphics.

NAVFAC
Naval Facilities Engineering Command
Engineering Service Center

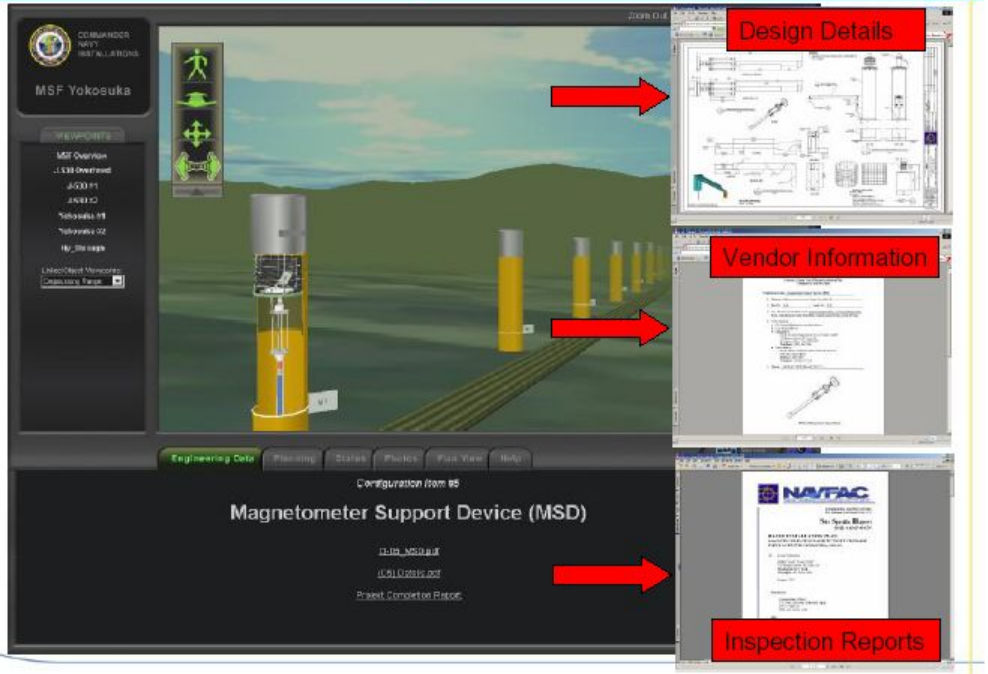
3D Model Production Process



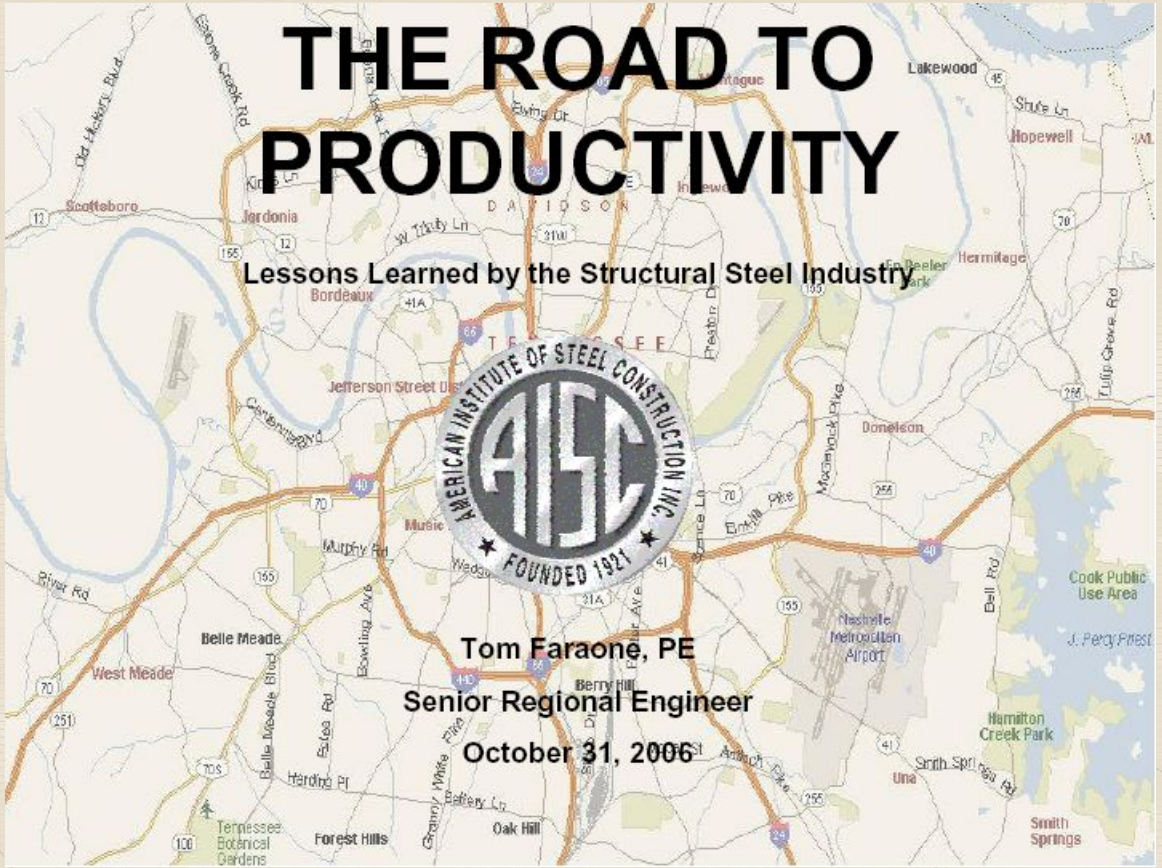


NAVFAC
Naval Facilities Engineering Command
Engineering Service Center

Virtual Earth Viewer for Navy Waterfront Facilities



THE ROAD TO PRODUCTIVITY



Lessons Learned by the Structural Steel Industry

Tom Faraone, PE

Senior Regional Engineer

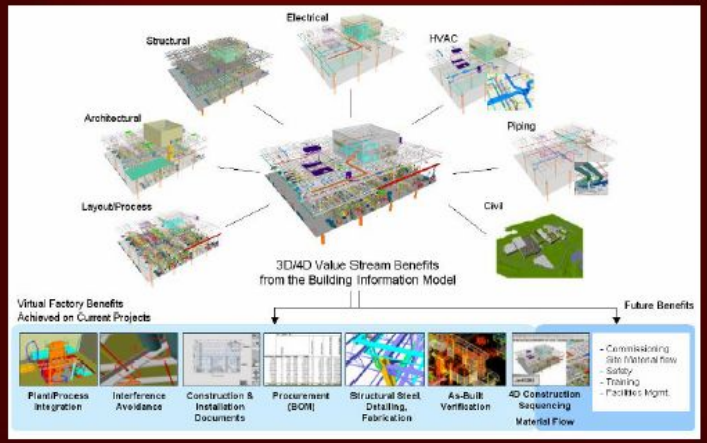
October 31, 2006

12 man-hours/ton

oadmap

M Roadmap

And then came BIM…



Lessons Learned from the Structural Steel Industry

TODAY

Today .5 man-hours/ton

1/3 the energy

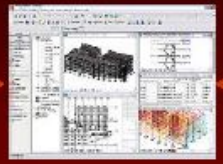
A BIM Roadmap

Wayne L Morse U.S. Courthouse
Eugene, OR

"Fastest GSA project ever."
"Change orders were less than 3%."

A BIM Roadmap

ARCHITECTURAL IFC

STRUCTURAL  IFC

HVAC IFC

CLADDING

Building Information Modeling horizontally integrates all building systems into a single, consistent design model allowing coordination of components and elimination of interferences.

INCREASED PRODUCTIVITY EQUALS

Greater Value

Lower Costs

Accelerated Schedules

Safer Construction

Lessons Learned from the Structural Steel Industry

BIM is merely an enabler

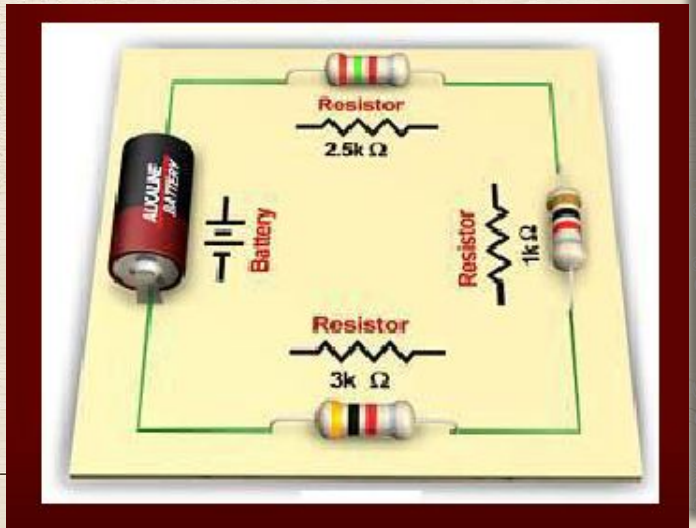
it may institutionalize process changes,

it does not drive change;

People propel organizational changes (Spitzer, 1996).

Institutional barriers and inertia yield slowly to data sharing and system interoperability initiatives, even when it is obvious that data sharing and interoperability will save time, money and lives.

RESISTANCES:



Coordination among standards organizations interoperability between geospatial and BIM environments

- The CAD-GIS Interoperability Working Group in the Open Geospatial Consortium, Inc. (OGC(R)) OGC Web Services Interoperability Initiative (OWS-4), which begins in April, 2006
- International Alliance for Interoperability (IAI) advancing BIM work based on the Industry Foundation Class (IFC) standard, and eXtensible Markup Language (XML) and XML-based GML expressions of IFC are being developed to improve the integration of geospatial as well as architecture, engineering, construction and facilities management (A/E/C/FM) information in a single model.
- The Open Standards Consortium for Real Estate (OSCRE) (www.oscre.org), a widely recognized e-commerce standards group working within the real estate industry. OSCRE works closely with an international organization, the Property Information Systems Common Exchange Standard (PISCES). The OSCRE standard enables the electronic transfer of real property information directly from one system into another, reducing or eliminating the need to send hardcopy and re-enter data manually.
- FIATECH (www.fiatech.org), a non-profit consortium focused on fast-track development and deployment of technologies to improve how capital projects and facilities are designed, engineered, built and maintained.
- OGC also has a formal collaborative agreement with the U.S. National Institute of Building Sciences (NIBS), which administers IAI for North America. Discussions with other IAI chapters are underway.

Emerging Technology Summit

ETS - IV: Convergence: CAD / GIS / 3D / BIM

Start: 2007-03-21 08:00 End: 2007-03-23 17:00

- Details: Presented by the Open Geospatial Consortium and the Geospatial Information & Technology Association
- This ETS will focus on those standards and the benefits of Building Information Models (BIM), including:
- * Designers and engineers will have lower costs and risks
  * First responders will be able to respond more quickly
  * Efficient monitoring will lower operating costs
  * Better views of facilities will lead to better decisions
  * Realtors, appraisers, and bankers will save money
  * Regulations compliance costs will be lower
  * Subcontractors' costs and risks will be reduced
- This Emerging Technology Summit and Workshop will be held at the Melrose Hotel
- Melrose Hotel
  2430 Pennsylvania Avenue, NW
  Washington, DC 20037
  Tel: 202 955 6400
  Driving Directions and Map

Elements of the Project Charter

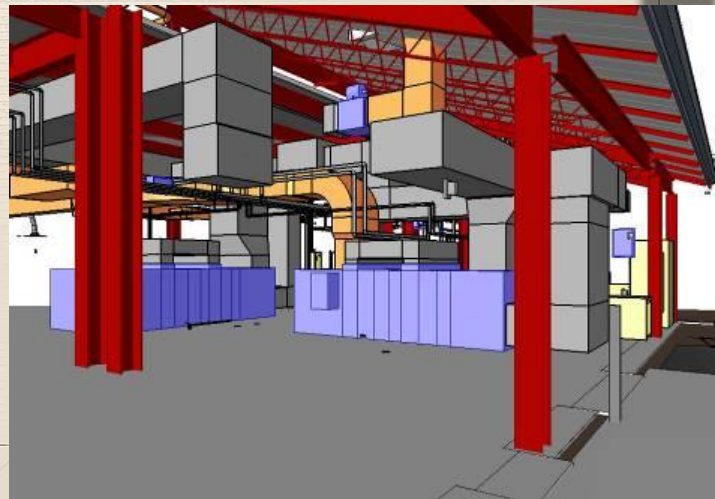
- Spatial awareness across AEC lifecycle is defined to be critical requirement
  - Inside and outside of a building
- Identify and define requirements where convergence between geospatial and building information across the building lifecycle is needed
- Review and where possible adapt geospatial standards-based workflows that meet requirements, save time and effort where convergence exists
- Identify existing standards that are ready for immediate testing for candidate status

BIM-GIS Project Focus

- How can BIM applications and information seamlessly interact with geospatial information during across the lifecycle process to address requirements related to site conditions and surroundings?
- How can BIM and geospatial applications be used to communicate campus-wide information requirements for lifecycle facility management and operations?
- How can 3-D CAD and geospatial portrayal services facilitate modeling in campus-wide and facility perspectives for as-is BIM model and further extension for planning or design activities?

BIM to GIS Integration Issues

- BIM is MUCH richer in detail than a GIS database
- GIS has only recently become fully 3-D
- Design BIM contains all the information needed to construct a building, but not to manage it
  - Space polygons
  - Occupant information
  - Asset details (make, model, etc.)
  - Equipment maintenance data
- Some of the missing data can be supplied by COBie
- GIS database and BIM will require network capabilities to share information



Fundamental Differences Between BIM and GIS

BIM (IFC)

- Highly standardized structure
- Parametric – highly structured
- File based
- File based exchange
- Inferior data exchange between COTS products
- Small number of users
- Thick client

GIS

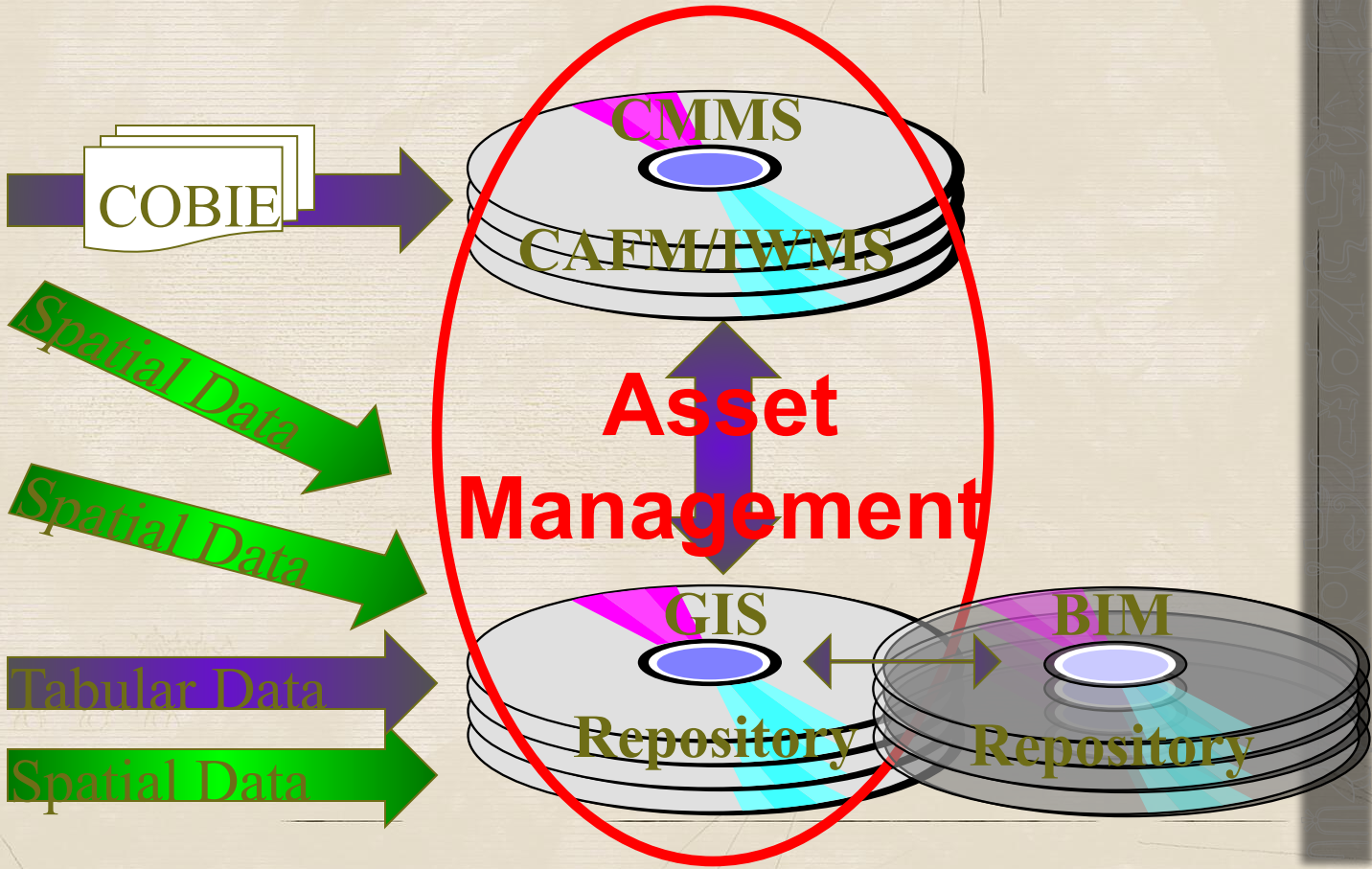
- User defined structures
- Parametric – loosely structured
- Server based - relational database
- File and web services for exchange
- Maximum integration flexibility
- Large numbers of users
- Thick and thin clients

Potential Integrated CADD/BIM/GIS Data Workflow

BIM Data

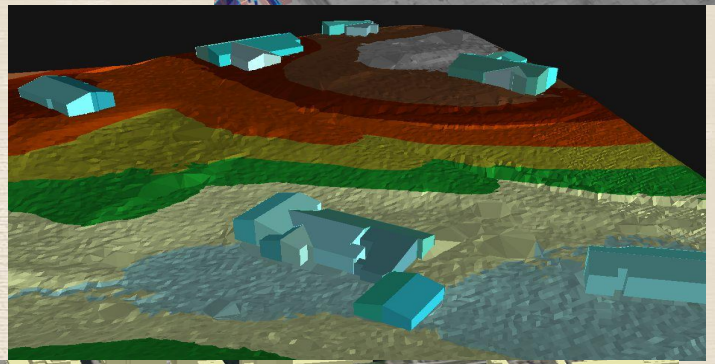
CADD Data

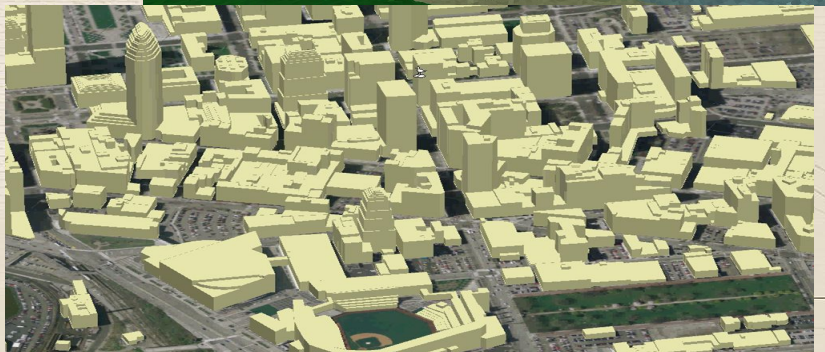
GIS Data



BIM – GIS Information Exchange Project

- BIM and GIS both play key roles in a facility lifecycle
- Both systems need to exchange data yet both serve as the repository for key data elements
- This Project will provide the basis for an information relationship between the two environments and their underlying databases

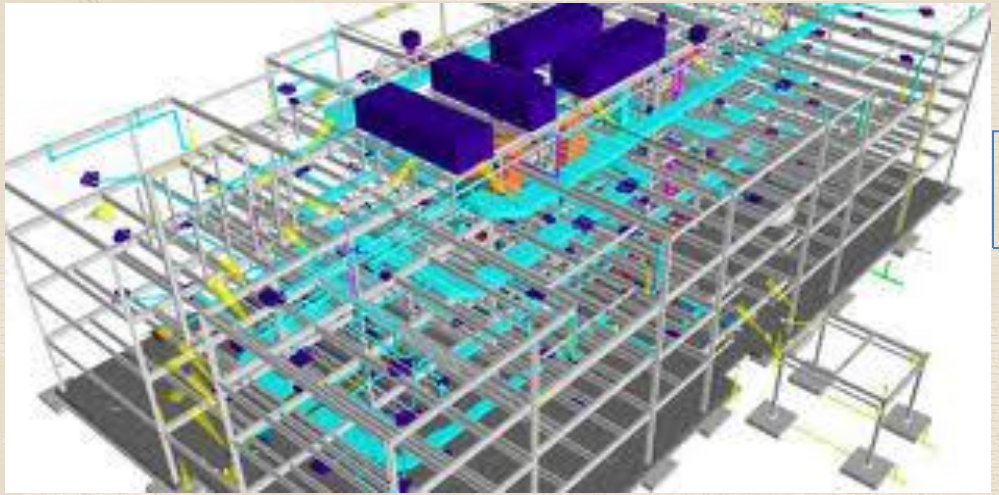




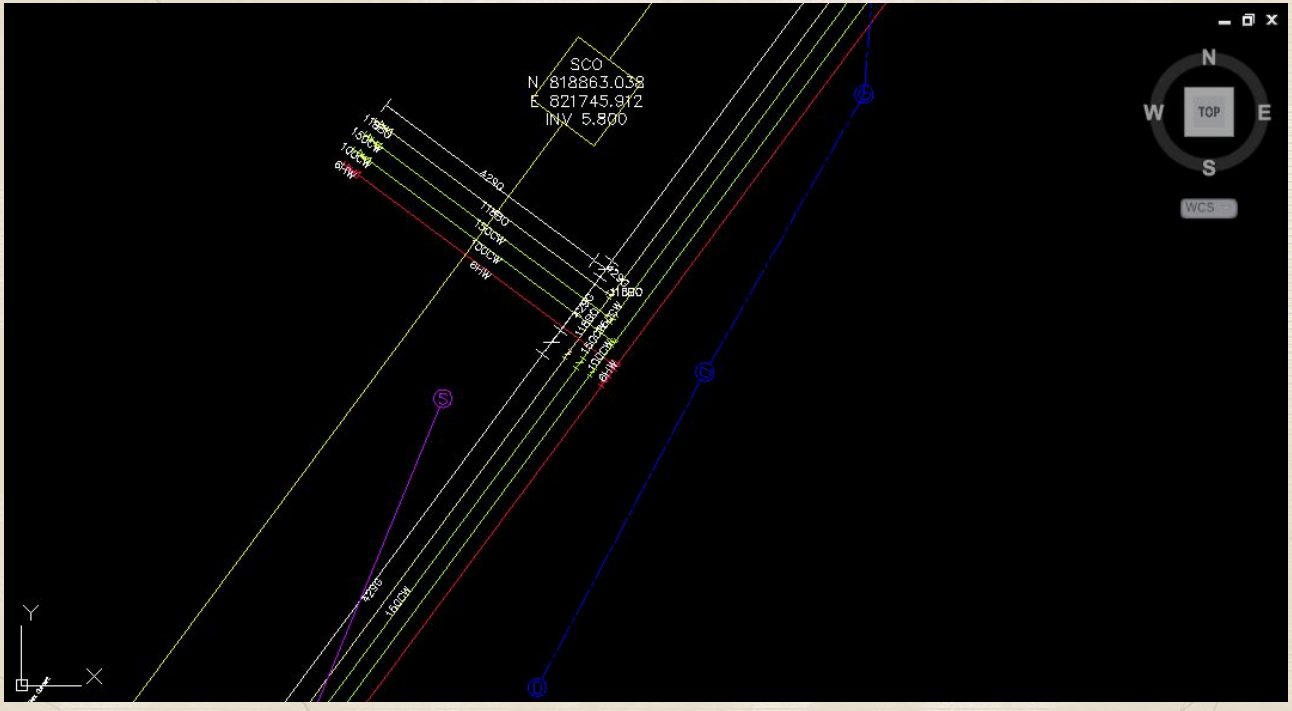
Urban design to Architecture

Engineering Schemes (simplified)

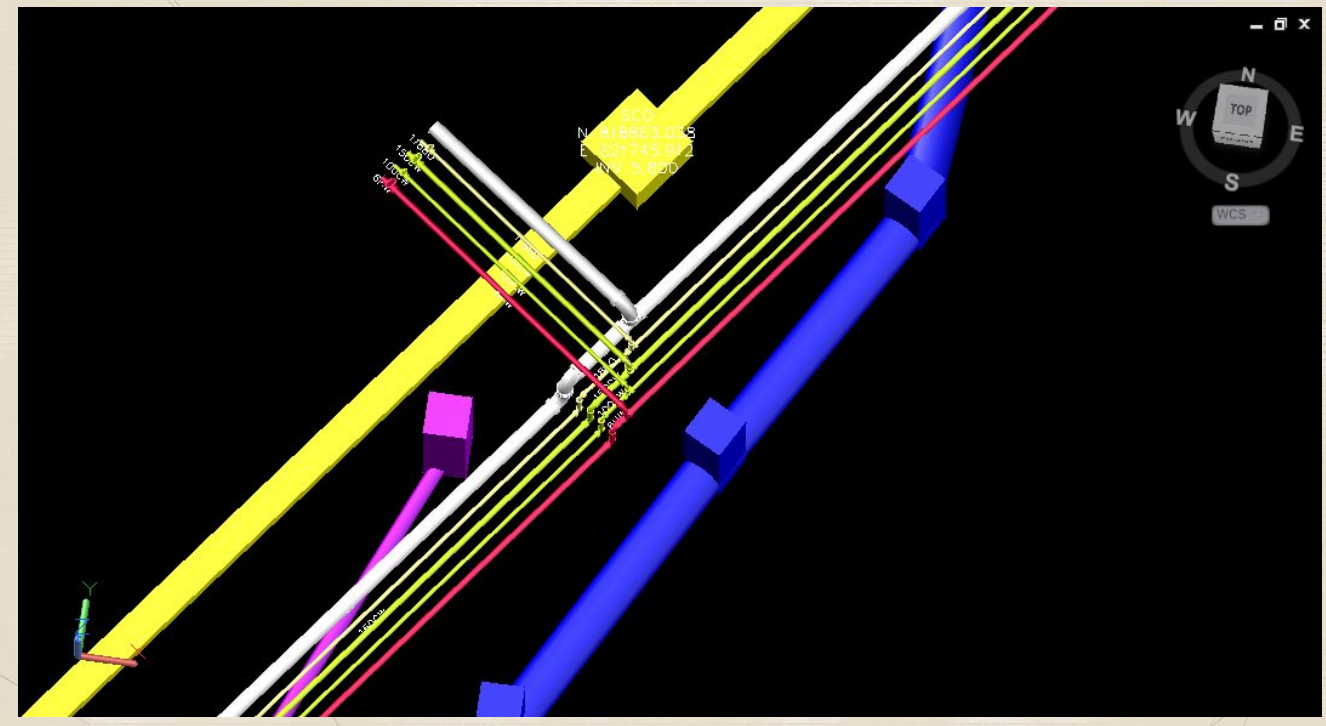
Construction



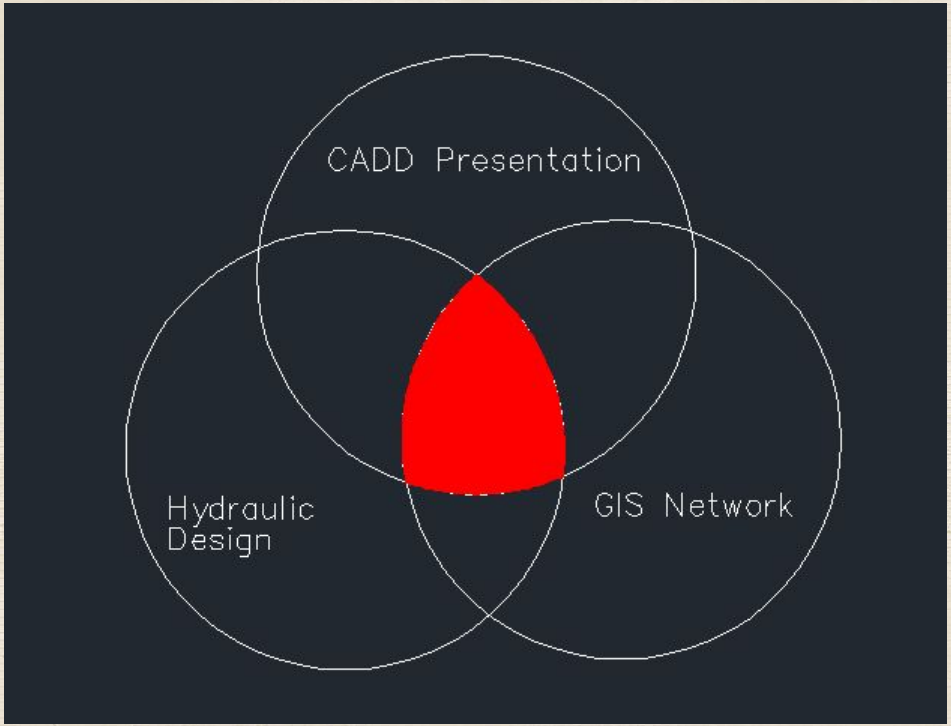
Underground Utilities - Plan View



Underground Utilities - 3D View

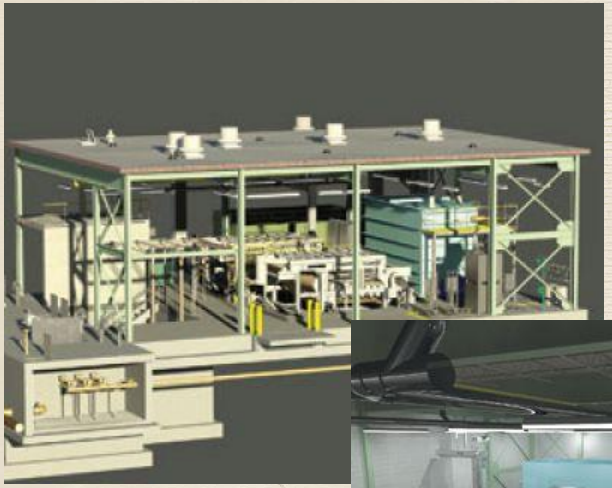


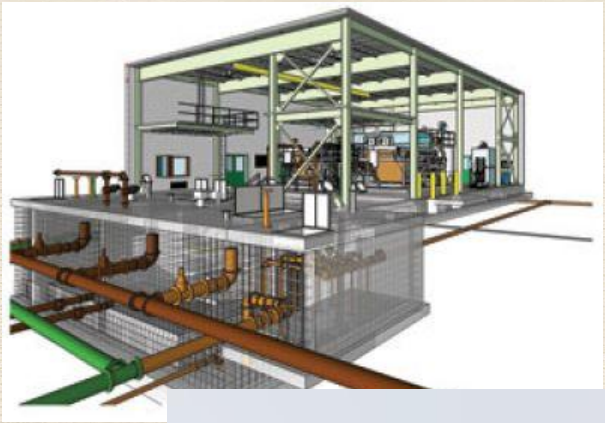
One Drainage Network Model for All



Lollipop Model by C K Ng, 1998

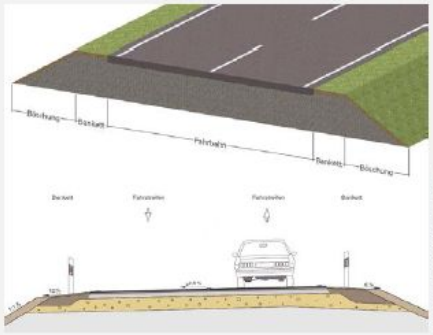
Station/Process Plant





Road/Bridge

Infrastructure Scope between GIS and BIM Standards – 2

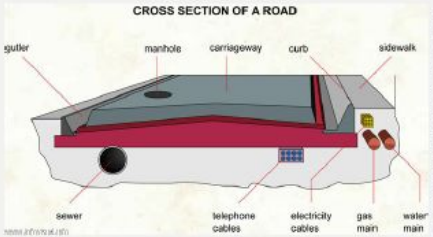


source: http://de.wikipedia.org http://de.wikipedia.org/wiki/Strat%C3%9Fenquerschnitt

Road Construction Sectioning

http://www.roadtraffic-technology.com/projekte/a1wineundsiwinesund3.html

Road Construction - Bridges



http://www.infovisual.info/05/025_en.html Copyright © 2005-2011 - All rights reserved

Road Construction Detailing

clearly BIM scope

- big scale
- engineering CRS
- mainly volumetric
- longitudinal structure
- element composition
- open – bSI / TC59 ?
- open – IFC ?

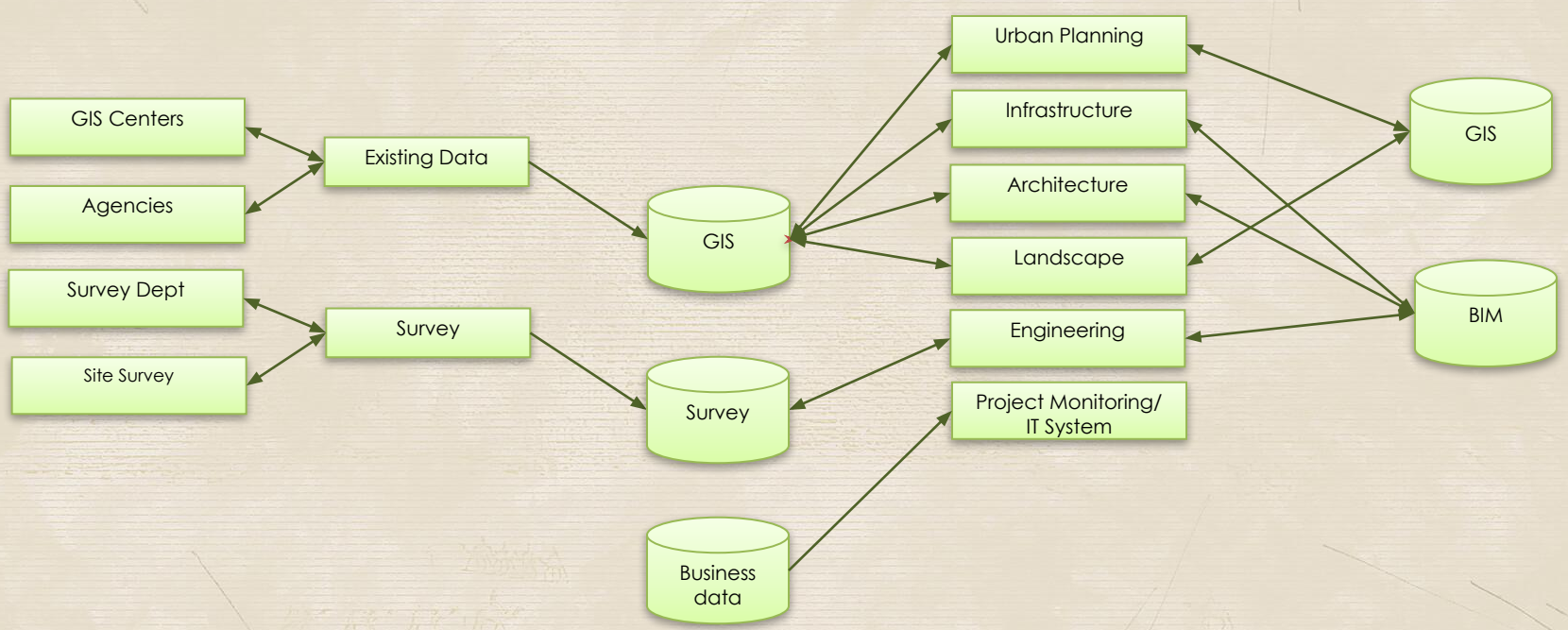
Key points of non coordinations

- At urban planning stage, site plans are created with very less emphasis on ground level accuracy.
- At Detailed engineering level, there will be need to precise survey of the site, where the plans created in the previous stage are no more useful.
- At the construction stage inputs from earlier stages are not carried in, due to lack of unified coordination.
- In most cases, spatial data is transferred as files (shape, dwg etc) to the next level.

Reasons

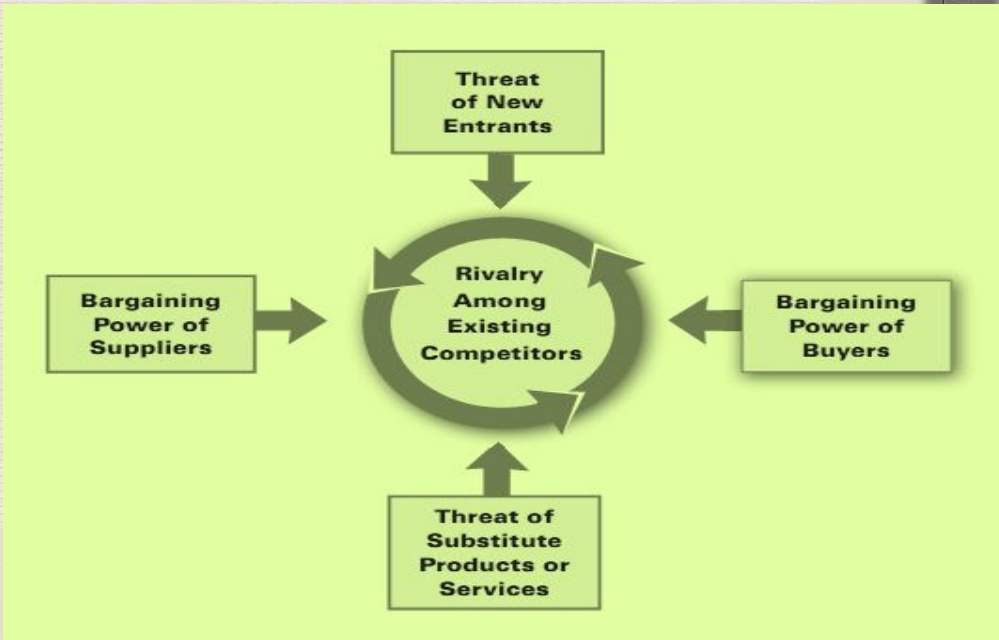
- Isolated business goals and targets.
- Lack of understanding of others businesses.
- Little understanding of the coordination perspective of technologies (using technology as coordination tool)
- When to do what (when to bring in technology)

Result - Silos model



Business Model for Integration

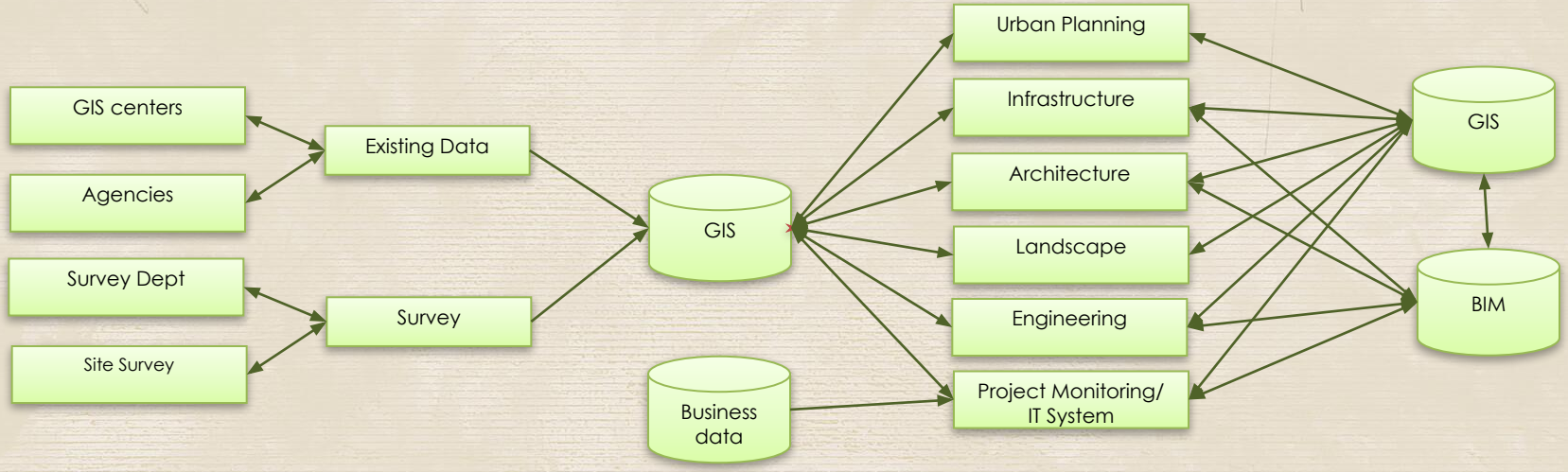
- Technologists and business leaders are forced to change and bring in better methods to survive in the business and be competitive.
- Michael E porters five competitive forces theory simplifies the reasons for organisations to be nimble.


Threat of New Entrants
Bargaining Power of Suppliers
Rivalry Among Existing Competitors
Bargaining Power of Buyers
Threat of Substitute Products or Services

Stake holders & roles

- Technology and domain experts should work together to evolve a solution.
- Design standards and data standards needs to be in place.
- A seamless data models (simple to complex) needs to be developed.

Integrated model



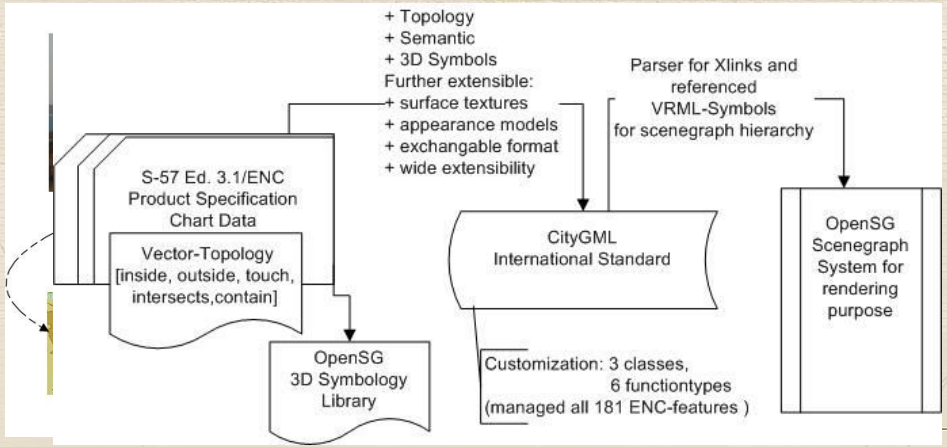
Key Technology changes

- Real time design and modeling – 3D GIS & BIM
- Unified data models - CityGML
- Intelligent data collection – scanners, sensors
- Extensive knowledge and analytics - GioBI

CityGML and AR

search for "augmented reality" citygml

- CityGML
  - Application scheme of GML
  - Structure for thematic modeling, semantic descriptions, appearance storage of 3D geometries and features
  - Aligned with IFCs and BIM standards
- Example: Extension of Electronic Nautical Charts for 3D interactive Visualization via CityGML. Haase and Koch, 2010


+ Topology
+ Semantic
+ 3D Symbols
Further extensible:
+ surface textures
+ appearance models
+ exchangable format
+ wide extensibility
Parser for Xlinks and referenced VRML-Symbols for scenegraph hierarchy
S-57 Ed. 3.1/ENC Product Specification Chart Data
Vector-Topology [inside, outside, touch, intersects,contain]
CityGML International Standard
OpenSG Scenegraph System for rendering purpose
OpenSG 3D Symbology Library
Customization: 3 classes, 6 functiontypes (managed all 181 ENC-features)

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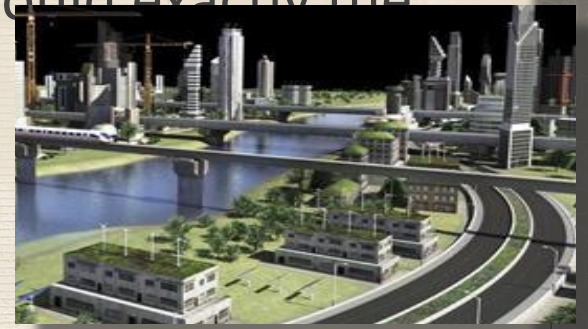
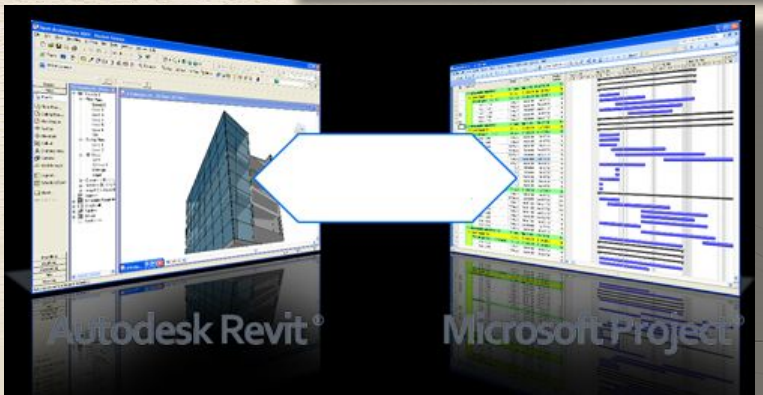
Real time design and modeling

Design activity will become more interactive, developers will get to know the cost, sustainability and project schedule (with 95% accuracy) before the project starts. They would exactly the following.

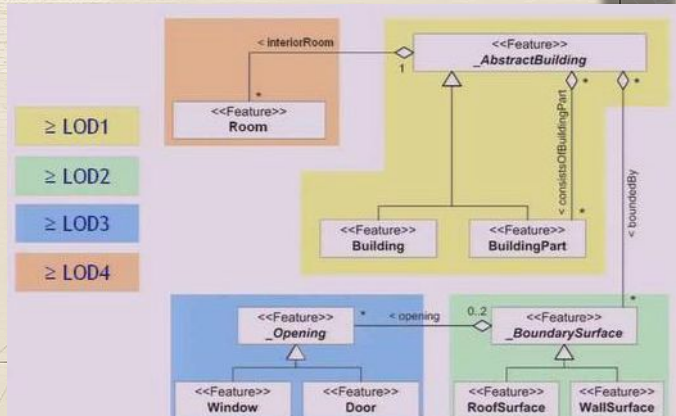


- Capital Investment
- Regulatory adherence
- Project time line
- Environmental sustainability
- Design
- Contractors
- Logistics



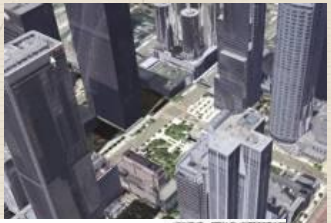
Unified data models - cityGML

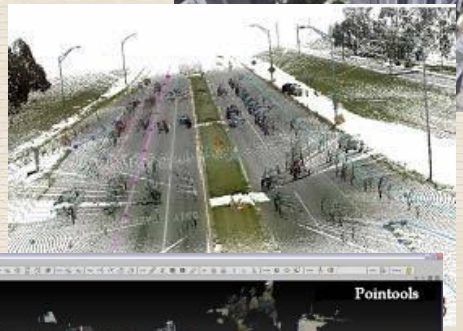
- CityGML plays a key role in making GIS & BIM to work together.
- Initiative of OGC to give a semantic city model (since 2005) is the first step to integrate 3D GIS models into upstream activities.
- BIM follows IFC standards which will also handle schedule, cost estimates, along with walls, roofs, floors, doors and other objects of building inventory.

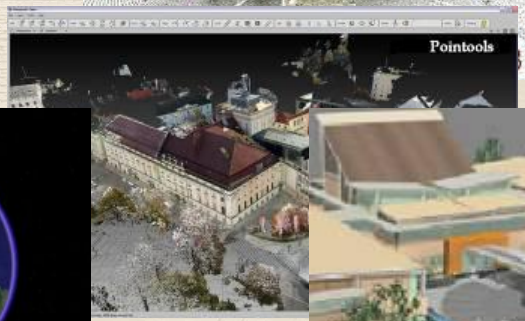


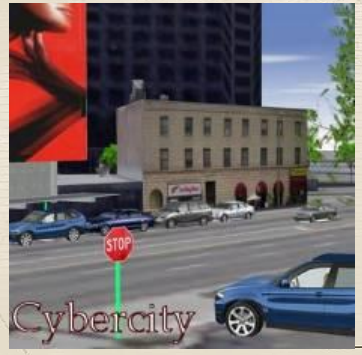
Why is CityGML necessary?

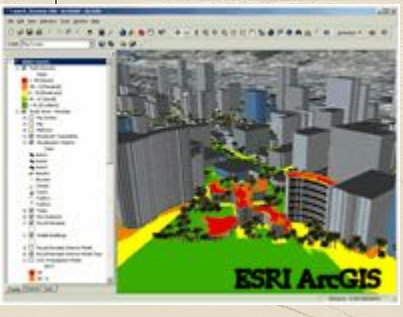
- Increasing interest in 3D
- Research shown a definite need for 3D
- Standards led approach











Web Services

- CityGML based on GML3 – combines with other OGC standards
- WFS, CS-W, WCTS and WPS especially
- Examples
- OGC Web Services – 4 (OWS-4) Testbed – showed how cityGML/IFC 3D data can be used in disaster management
- Statewide 3D SDI with cityGML – NRW. Noise modelling
- SDI Berlin – city urban planning, civic participation etc
- Heidelberg

Software supporting cityGML

- 3D Geo **LandXplorer** CityGML Viewer (free)
- University of Bonn: **Aristoteles** Viewer (free)
- Snowflake Software: **Go Loader & Publisher** WFS
- Interactive Instruments: WFS
- **Oracle** 11g: 3D data types and CityGML loader
- Tech. University of Berlin: **Oracle schema/loader/updater**
- Safe Software **FME** reader (writer in development)
- ESRI – ArcGIS 9.3 – **Interoperability Extension**
- **Bentley**: Work in progress
- **Autodesk**: Work in progress

Extending CityGML

- 2 methods for extending basic functionality of cityGML
  - Generic Objects/Attributes
  - Application Domain Extensions

- Generics – allow extensions during runtime i.e. no additions to XML schema
  - Classes GenericCityObject & GenericAttribute
  - Only used for features not in cityGML model
  - Issues
    - May occur arbitrarily – no formal specification, reduces semantic interoperability
    - Naming conflicts may occur

Application Domain Extensions

- CityGML – Base information model. Specific applications need extra information. E.g. Environmental simulations, Utility networks, etc
- Types of domain extension
  - Extend existing cityGML feature types
    - Extra spatial/non spatial attributes
    - Extra relations/associations
  - Definition of new feature types
    - Preferably based on cityGML base class CityObject
  - Each ADE requires its own XML schema definition

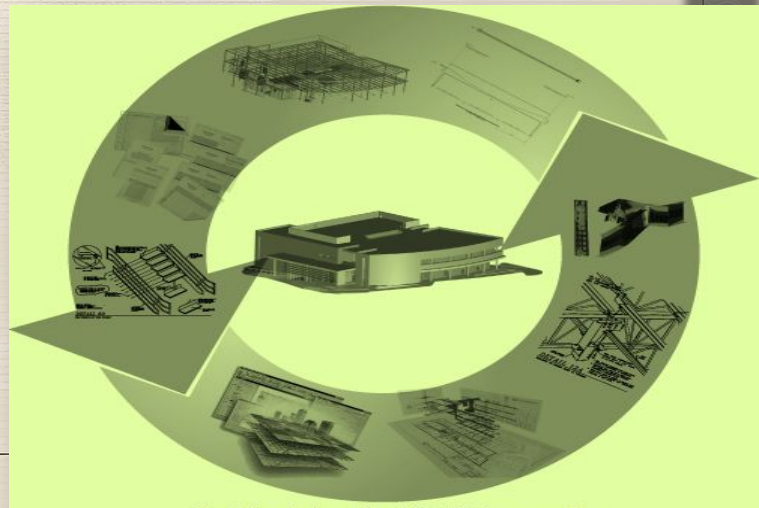
Large models:
55 000 detailed buildings

(>50km2

Image: Reality maps, Berlin 3D

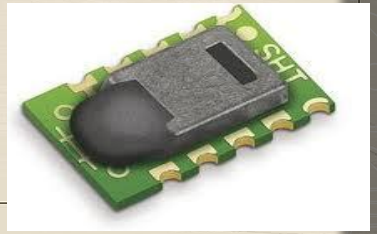
How to complement

- GIS bring in strong spatial analysis of location and surrounding.
- GIS forms the base of the next level.
- BIM is good for Specific construction site analysis (LOD 4), design, sharing and project management.



Intelligent data collection- sensors

- Geo enabled Sensors play a vital roles in developing and managing smart cities.
- KPIs like, traffic, vehicular pollution, industrial pollution, energy consumption and resulting carbon foot prints are monitored using various types of sensors.



Geo Business Alalytics - GeoBI

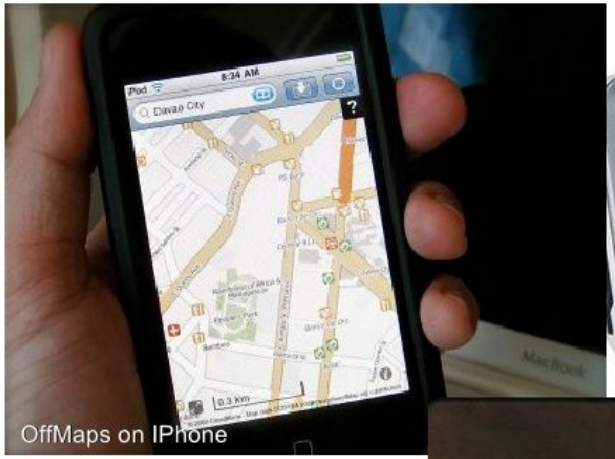
- Display, query and analysis of large data is always a challenge for GIS users.
- GeoBI would help to query analyze huge volumes of data in very short time.
- GeoBI can also seamlessly work through number of sources and provide.

What is OpenStreetMap?

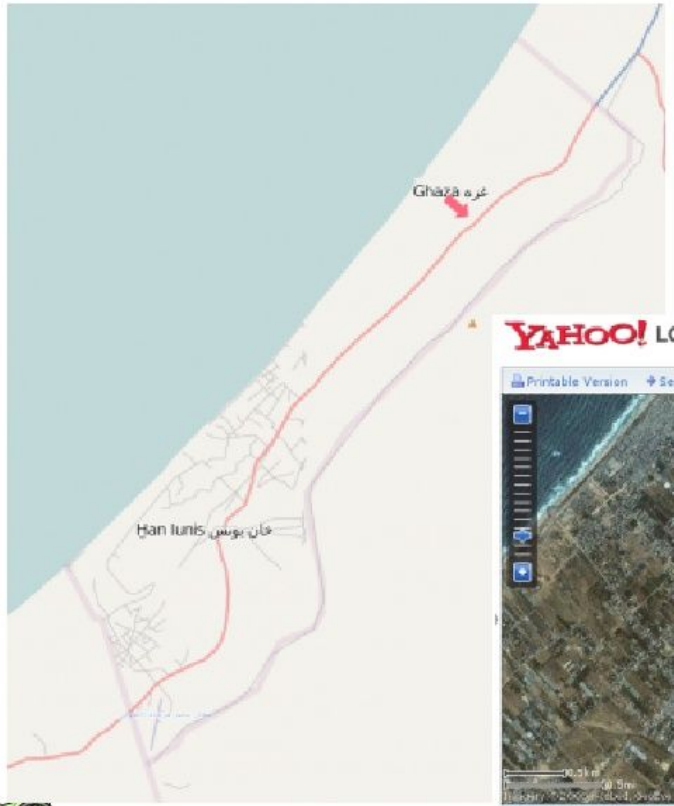
- Geographic data
  - For driving, riding, walking, boating, skiing, hiking, anything
- Free
  - Currently CC-BY-SA, moving to ODBL
- Wiki-like editing

http://www.osm.org

Available on many devices

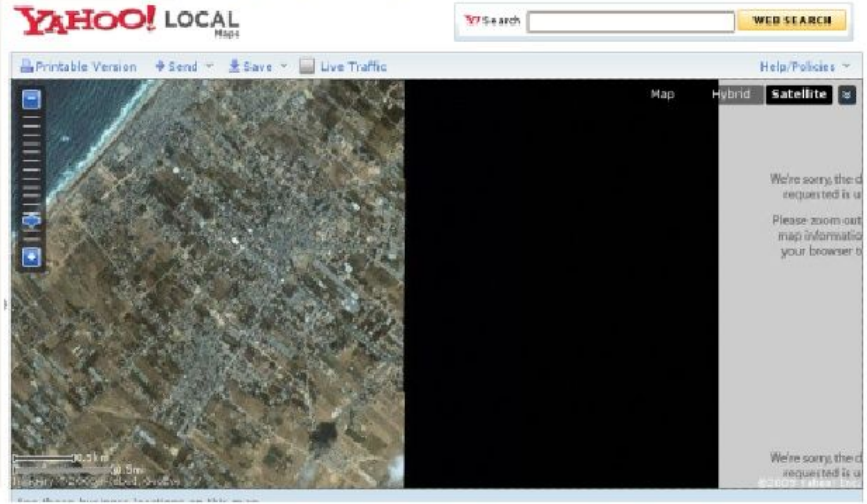


OpenStreetMap Gaza Project

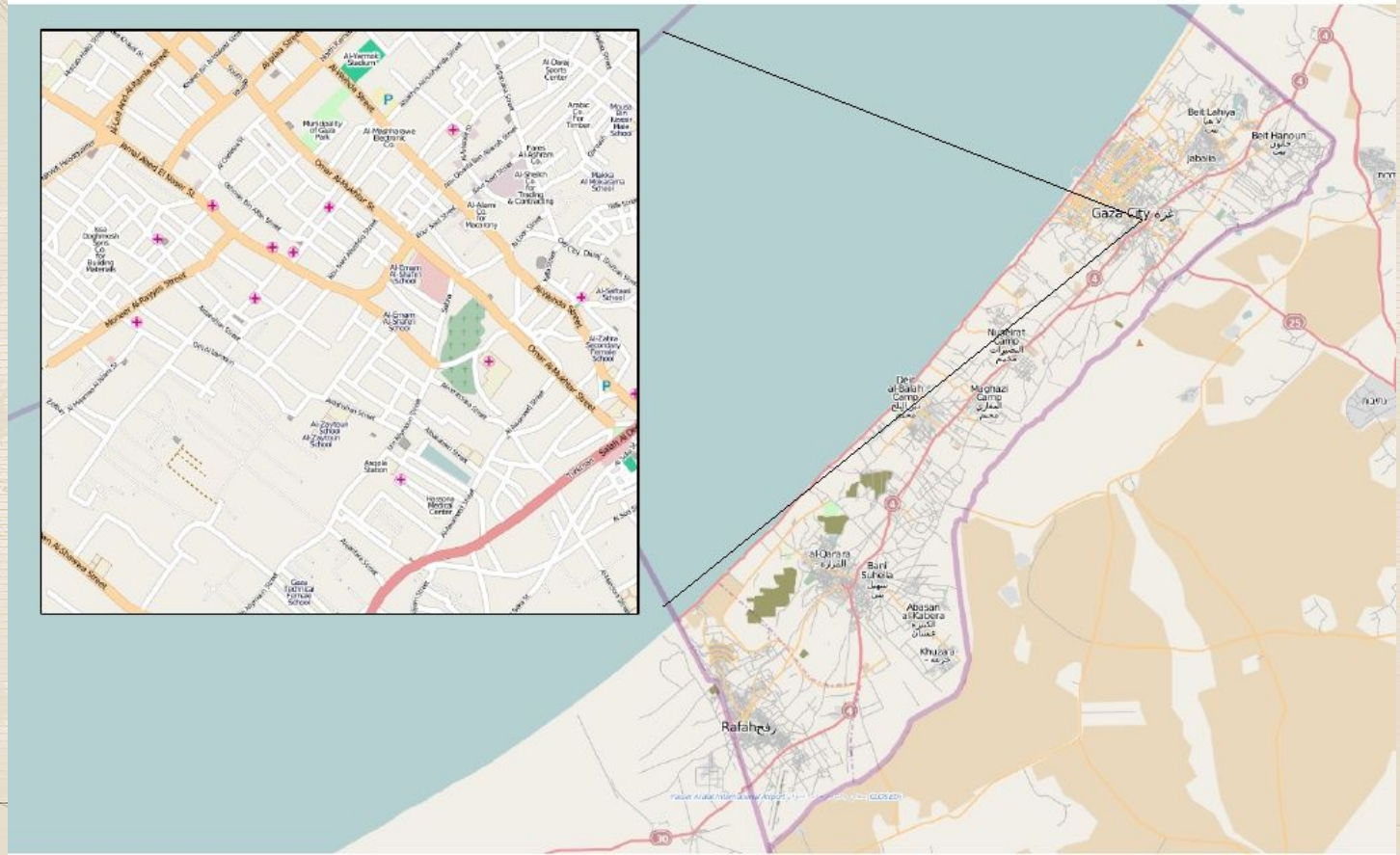


Jan 2009: Mikel Maron announces OpenStreetMap Gaza Project

Feb 2009: Mapping begins with purchased aerial imagery (~ $6000)



Gaza Strip today



Use and Media Coverage

Uses of OpenStreetMap data by crisis responders

People on-the-ground in Haiti (and related organisations) are using (or used) our maps :

- Thanks message from Colombian Mission in Haiti. (2010-02-10)
- "This is where OpenStreetMap is a godsend" in How to Deploy Long-Distance WIFI in Haiti (2010-02-10) by Inveneo, a NGO whose mission is connecting those who need it most, on how they were able to bring high-speed Internet access - critical communication capacity - to eleven relief agency locations with minimal equipment and installation time.
- On 13/01/2010 ITHACA and WFP published their damage assessment of Port-au-Prince using OSM road data.
  - Special session on mapping the disaster during the Haiti Emergency at the GI4DM 2010 Conference
    See subpage GI4DM2010
- OpenStreetMap renderings on Garmin GPs receivers by Colombian search and rescue operators - *"Many thanks Freddy. Very timely maps of Haiti that sent me to the Garmin. I went down and installed the GPS in our search and rescue teams. OSM undoubtedly be a great help to our response teams, especially those going to move to rural areas."* via outcunH (2010-01-15)
- Fairfax County Urban Search & Rescue Team Using
- Unitar / UNOSAT use OpenStreetMap street data in t
- GDACS use OSM street data in their reports
- JRC use OSM street data in their report
- "I'm told OSM is on the big monitors at SOUTHCOM.
- On 18/91/2010 ITHACA and WFP released maps
- NOAA's Environmental Response Management Appl
- The Food and Agriculture Organization (FAO) (http:/
  (http://fenix.fao.org:8080/fenix-web/org.fao.fenix.we
- The Office for the Coordination of Humanitarian Aff
  Wiki as a resource (Social Media Links category) for
- Secretary of State Hillary Clinton, Remarks on Inter
- Kjeld Jensen, Red Cross (IFRC): "Hello guys, I just wa
  is impressive. It has already saved me and my drive

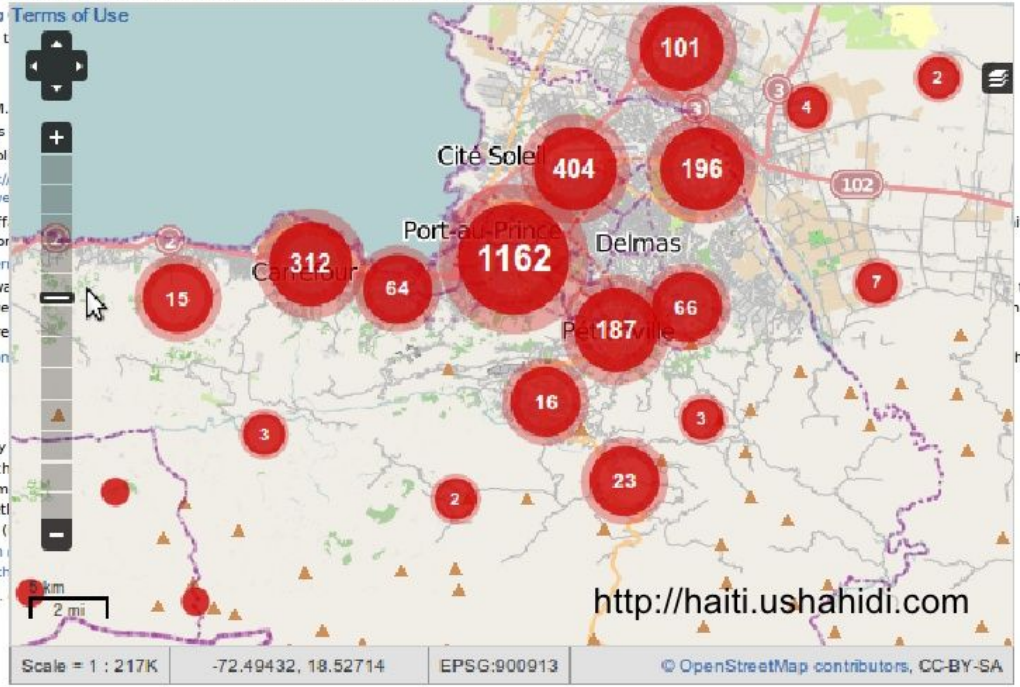
Again thanks a lot guys, we are really running fast here

- Jihad Abdalla from UNICEF (http://groups.google.con
  here...Million thanks."

Other earthquake related websites using our maps :

- Atlas compiled by the Center for Interdisciplinary
- flickr.com - the massive photo sharing site switch
- http://haiti.ushahidi.com/ - plotting "reports" from
- MapAction (http://mapaction.org) use OpenStreetI
- Information Management & Mine Action Programs (
- World bank printed a giant poster for their SitRoom
- OpenStreetMap data is being shipped on drives to th

There are many alternative renderings/map views too.



Use and Media Coverage

Uses of OpenStreetMap data by crisis responders

People on-the-ground in Haiti (and related organisations) are using (or used) our maps :

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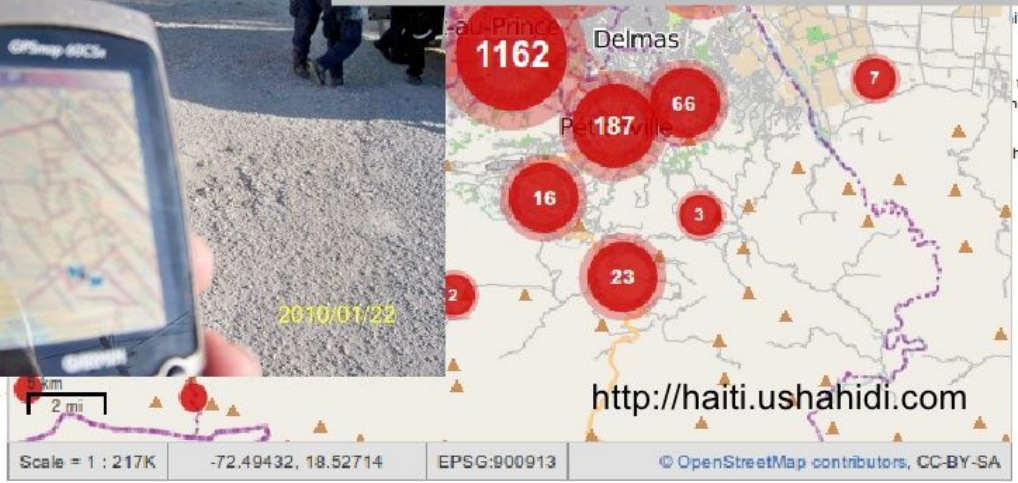
Other earthquake re

- Atlas compiled
- flickr.com - the
- http://haiti.ushahi
- MapAction (http:/
- Information Mana
- World bank printe
- OpenStreetMap d

There are many alternative renderings/map views too.

"Hello guys, I just wanted to let you know that your work on improving the Haiti maps is really appreciated here. A few days ago I installed a version on my Garmin Oregon GPS and the result is impressive. It has already saved me and my driver from getting lost twice, and the alternative would have been long delays. In the coming days I will try to update our Red Cross relief GPS receivers with your map." - Kjeld Jensen, Red Cross (IFRC)



OSM.EG
OSM.EG
OSM.EG
OSM.EG
OSM.EG
openstreetmap egypt

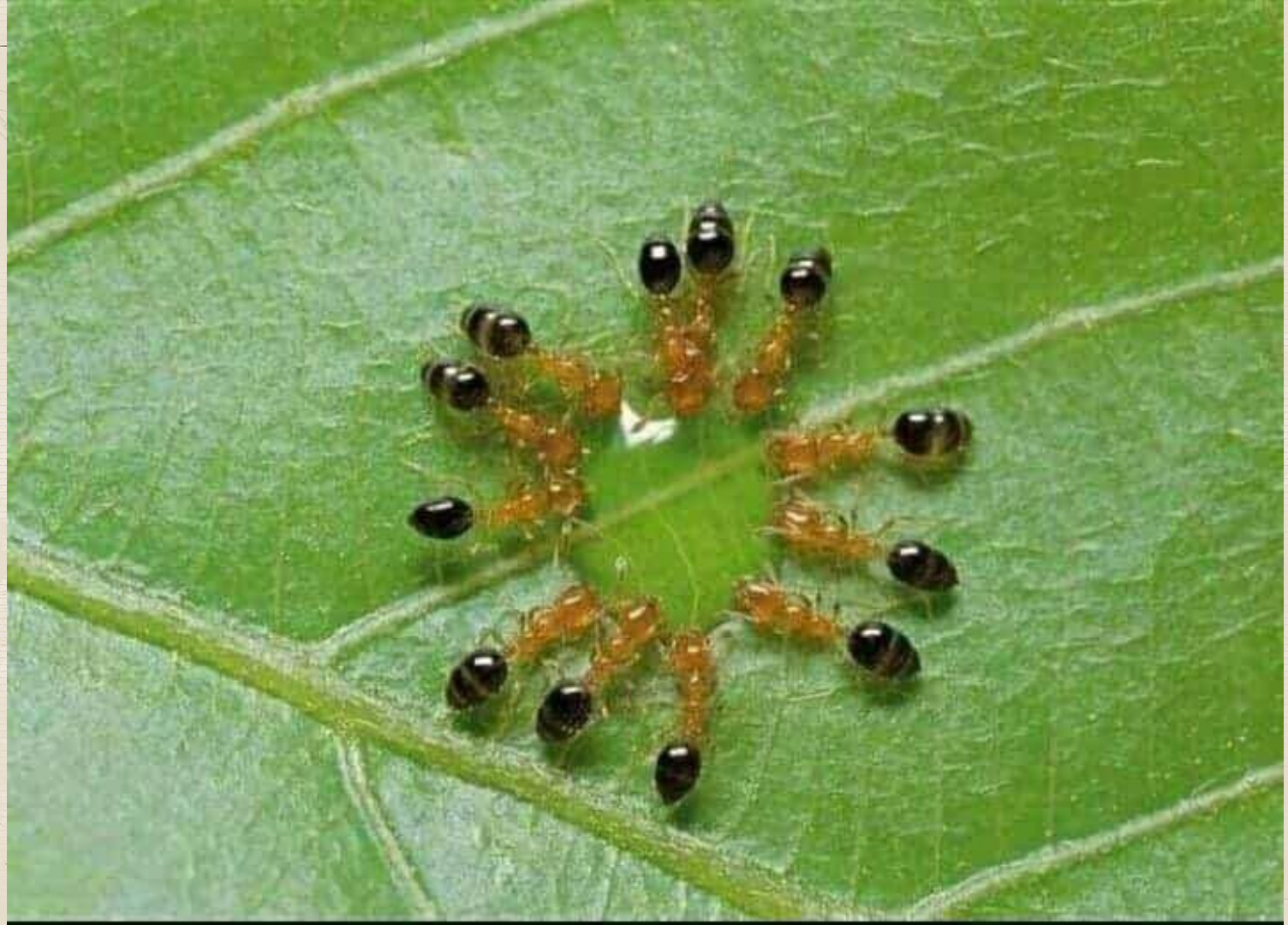
Conclusion

- Geospatial shall a very vital role in future ‘smart city’ initiatives .
- If Sustainability is the way forward for future cities. There is NO way forward with Geospatial platforms in place
- Integration, ability to work with GIS & BIM ambidextrously will yield great results.

Six steps to become a Smart City

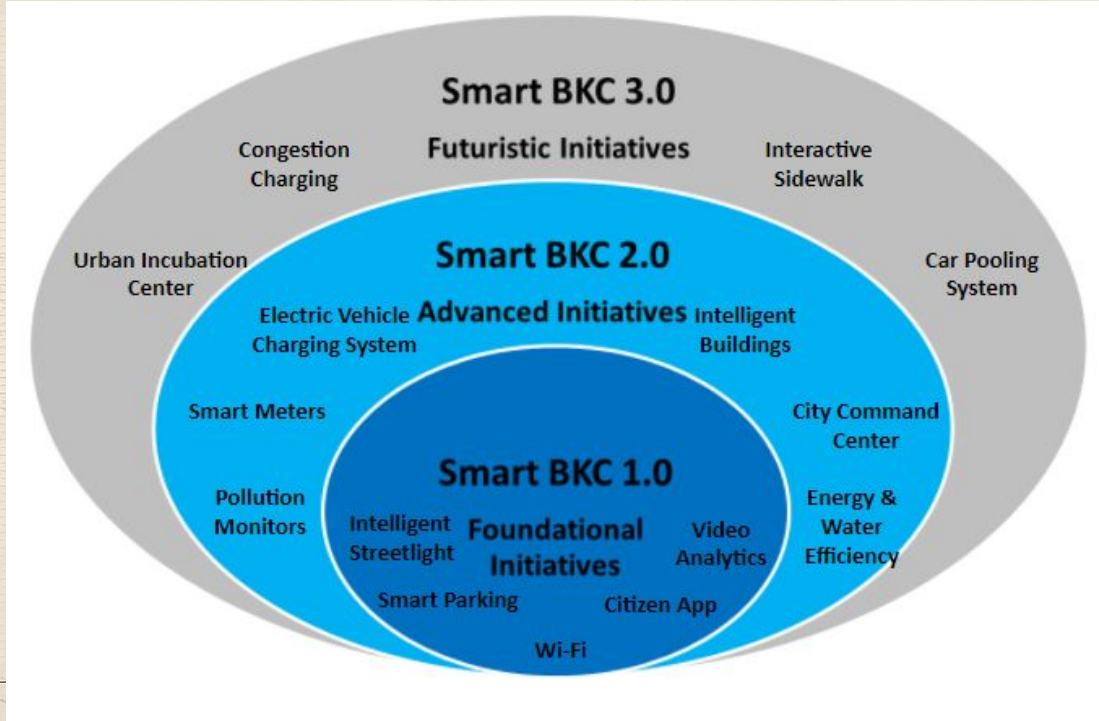
Determine your starting point
Develop a clear and objective understanding of the current situation across multiple relevant parameters.
Identify your objectives
Critically identify the objectives behind your decision to embark on a Smart City journey.
Define a set of projects
Identify potential Smart City projects for each objective.
Assess the likelihood of each project's implementation success
For each project identified, assess the success factors for implementation using the Smart City Piano.
Assess the impact of each project
Assess the impact of each Smart City project based on the identified objectives.
Select the most promising projects
Select the most promising projects according to the Smart City Project Selection Matrix.

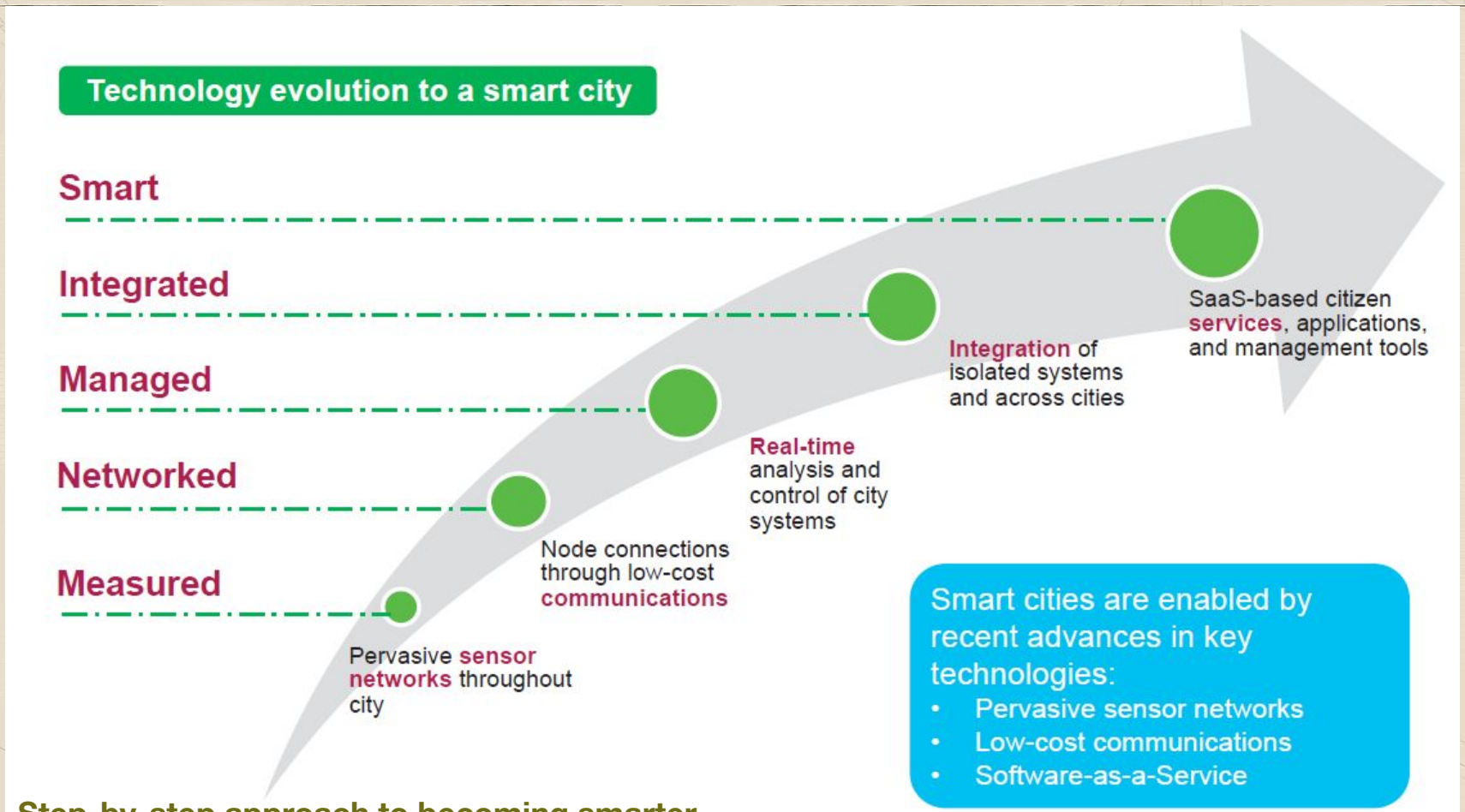
Examples Of Smart City



Smart BKC Plan- Phases

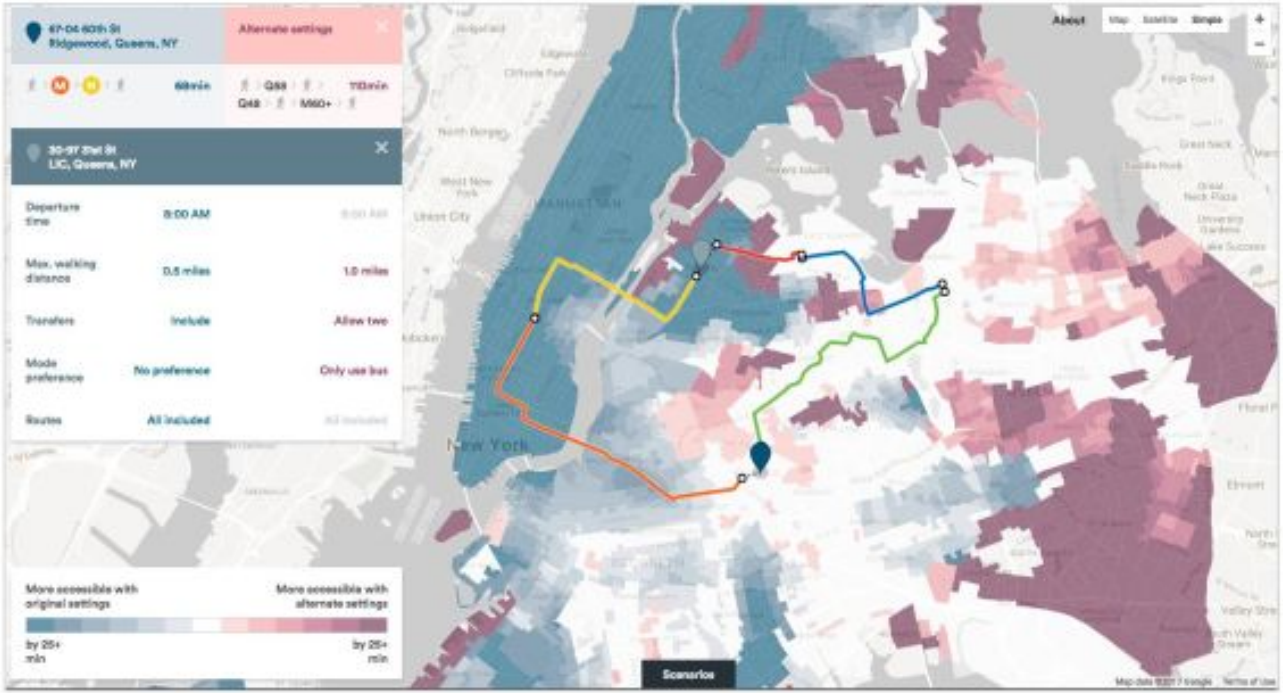
MMRDA has started its Smart City journey with focus on creating BKC as Intelligent Region and identified Top 5 solutions to create foundation for Smart BKC.




Technology evolution to a smart city
Smart
Integrated
Managed
Networked
Measured
Pervasive sensor networks throughout city
Node connections through low-cost communications
Real-time analysis and control of city systems
Integration of isolated systems and across cities
SaaS-based citizen services, applications, and management tools
Smart cities are enabled by recent advances in key technologies:
• Pervasive sensor networks
• Low-cost communications
• Software-as-a-Service

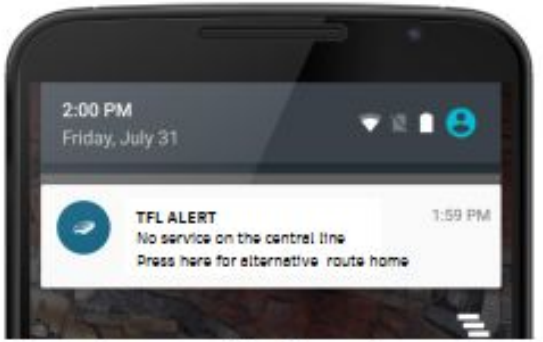
Step-by-step approach to becoming smarter

Transit delays and cancellations – lead to frustrated passengers and over crowded stations



Use data to pre-plan alternatives and understand impacts elsewhere

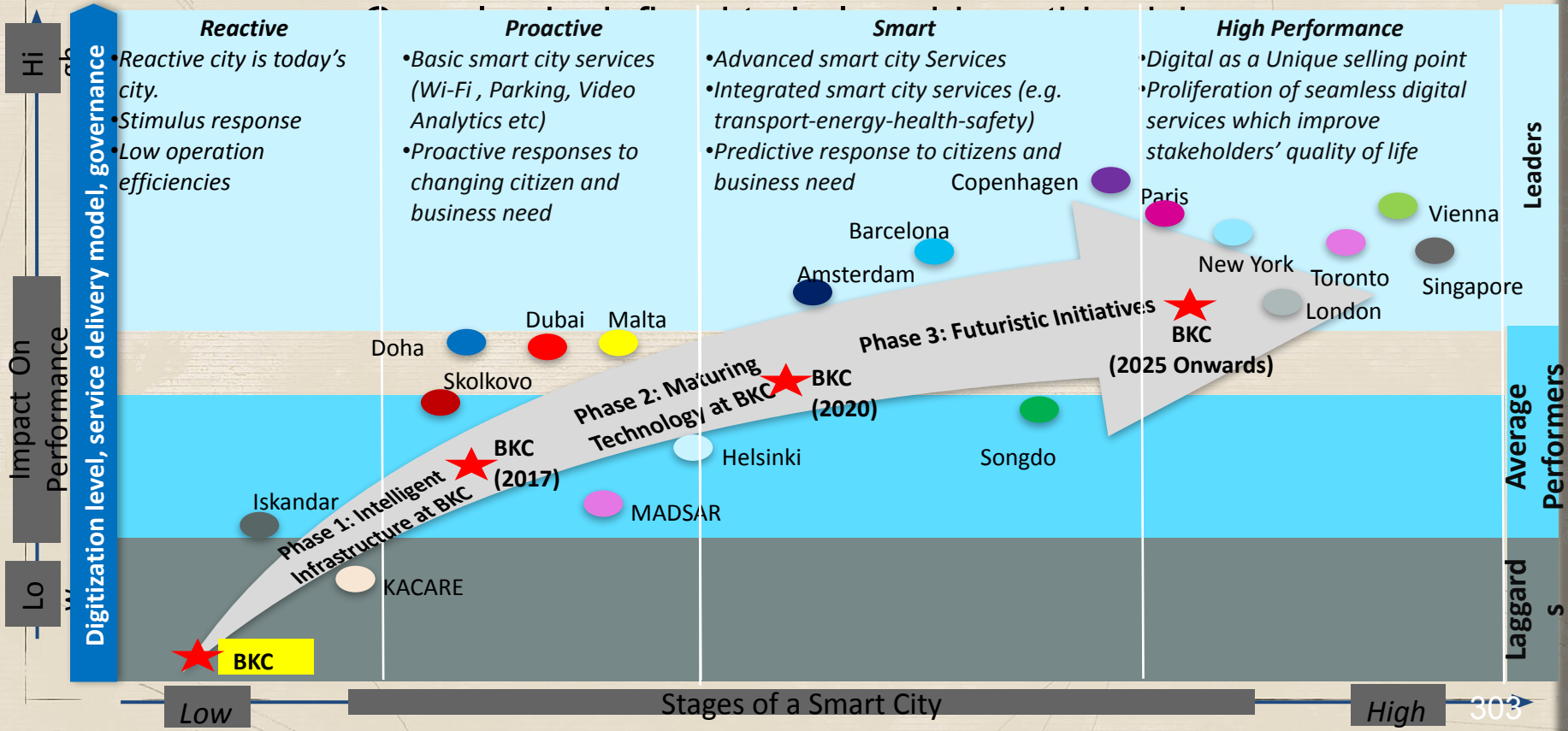
Example: Sidewalk Labs LLC's L line shut down in NY



Alerts to users with alternative route calculated on busyness and travel history

Interactive totems outside the station provide information and alternative routes

Based on the various smart cities across the globe, a smart city Journey for Bandra Kurla



5 initiatives earmarked for Smart BKC 1.0, Making BKC as a Smart City

1.Public WIFI	2. Smart Parking	3. Smart Street Lighting & Grid	4. Video Analytics & Surveillance	5. Citizen Apps
5 MBPS High Speed Wireless Internet Connectivity	3000 Smart Parking Slots	841 Streetlights based on Solar power	Complete E & G Block covered with 90 cameras	33000 man-days saving due to ease of access of information
175 Hectare Area Covered in Public Wi-Fi in BKC	Parking Time Reduced from 20 minutes to 5 minutes	800 tonnes of Carbon Reduced Annually	Greater coordination among Security Agencies	Improves Citizen Communication
Seamless Wi-Fi Connectivity Across E& G Blocks	19000 Liters of Fuel saved annually	Energy Consumption reduced by 40%	Reduced Street furniture theft	Improved Emergency Alert and Response
50,000 man days saved per year	24 tonnes of Carbon Reduced Annually	200KW of Clean energy generated	Improved Emergency Response	6.5 lakhs Employees Covered
Public Wi-Fi as Value Added service for Business and Exhibition Use	Reduction in Unauthorized Parking	Reduced Maintenance Cost	Secured Business Environment	Increase in ease of Business in BKC

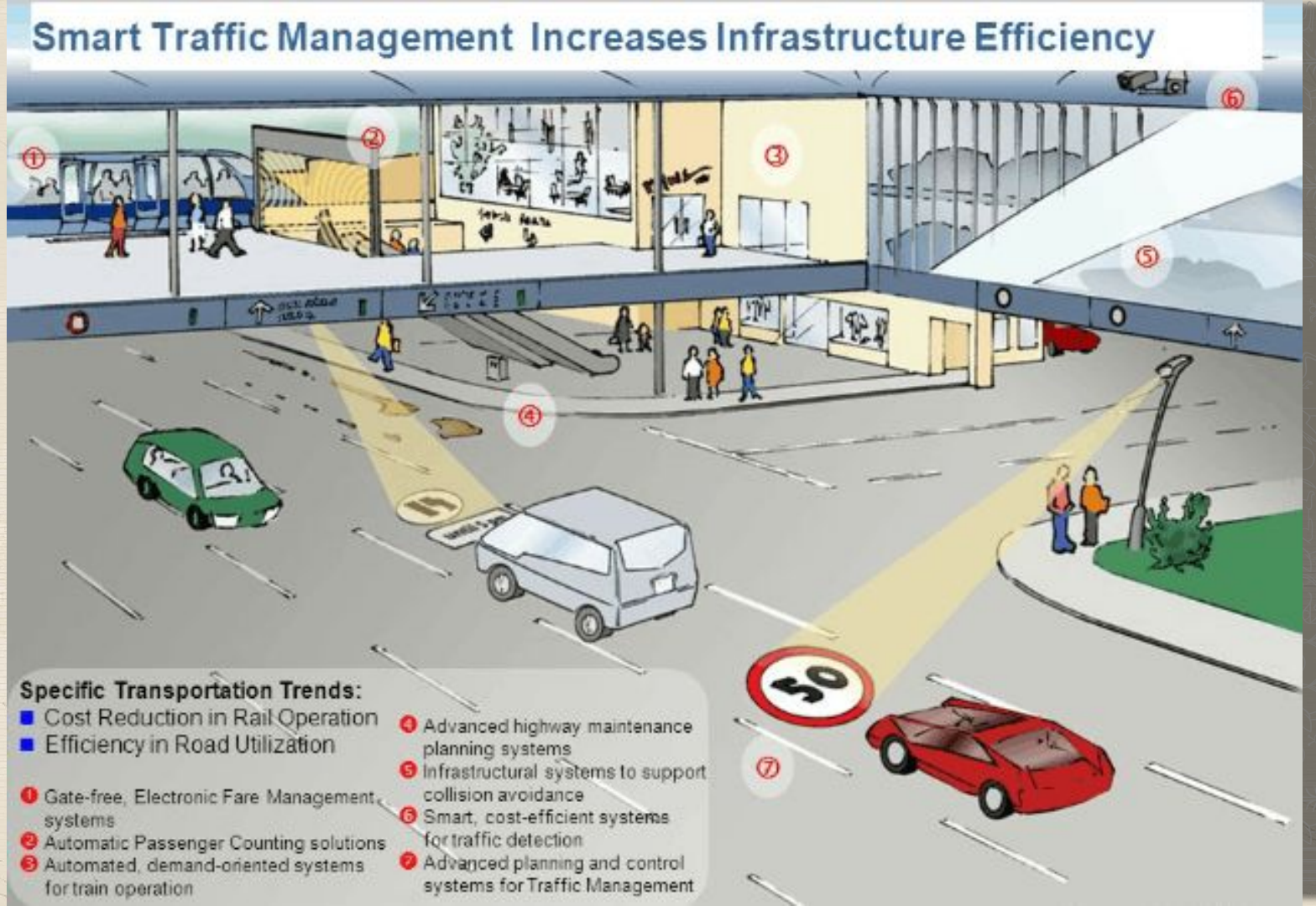
Cost Estimates	
• Capex: Rs 19.41 Cr.	• Break Even: 7.38 years
• Opex 1st yr: Rs 5.51 Cr.	• Total Project Period 10 years
• Annual Revenue generated: Rs 7.91 Cr.	• IRR : 16%

Present Status
• EOI Received on 02.12.2014 and scrutiny under progress
• **23 Lead bidders have participated with 2 global consortium and 21 Indian Firms**

Next Phase Once phase 1 Smart BKC solutions have been implemented additional initiatives can be build upon the existing capabilities as next quick wins

Wi-Fi	Smart Parking	Intelligent Streetlight	Video Analytics	Citizen Mobile Application
▪ BKC Wide Wi-Fi ▪ Communication Backbone for Parking Sensors, CCTVs, Kiosks	▪ On Street, Open and In Door Parking ▪ Parking Guidance App ▪ Parking Space Management ▪ Parking Reservations	Lighting ▪Light & Motion Sensor Solar ▪200 kw Grid Tied Solar PV	▪ 50 new cameras to cover entire BKC ▪ Integration with Mumbai CCTV ▪ Command Center at MMRDA and BKC Police St.	▪ BKC Information ▪ Key Contacts ▪ Citizen Involvement Mobile App ▪ Kiosks
Extend for more Smart City Apps ▪Air Pollution Sensors ▪Smart Meter (Electric/Water/Gas) ▪Water Quality Meters ▪Flood Sensors	▪ EV Charging Stations ▪ EV Charging Station Locator ▪ Differential Parking Charging	Lighting ▪LED Retrofit Lighting Solar- expand to 1 MW ▪Solar PV on Buildings (Terrace and Façade) ▪Solar PV on Bus Stops	▪ Extend Command center at MMRDA to City Command Center ▪ Feed to Transportation Planning	▪ Citizen Involvement in Planning ▪ Citizen Services -GIS and ERP Integration

Bengaluru


Smart Traffic Management Increases Infrastructure Efficiency
Specific Transportation Trends:
Cost Reduction in Rail Operation
Efficiency in Road Utilization
1 Gate-free, Electronic Fare Management systems
2 Automatic Passenger Counting solutions
3 Automated, demand-oriented systems for train operation
4 Advanced highway maintenance planning systems
5 Infrastructural systems to support collision avoidance
6 Smart, cost-efficient systems for traffic detection
7 Advanced planning and control systems for Traffic Management
50

Bengaluru

Area Based Development

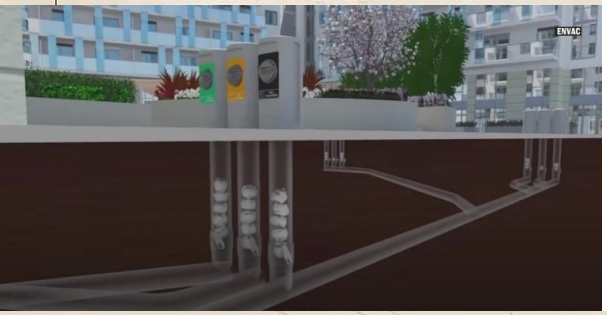
- **Revitalization Of Historic Heart Of City**
- Infrastructure revitalization (increase in capacity and coverage)- power, sewage system, water supply, Surface drainage, and telecommunication
- The city center needs the highest degree of walkability due to the highest footfall number
- **Integrated Mobility Towards Creating Vibrant Destination**
- Building on Tender SURE and Proposed Metro Station
- Combining Shivajinagar bus depot to Russell Market through an overhead pedestrian bridge
- Reuse of underutilized public area and infrastructure towards economic viability
- **Upgradation & Redevelopment Of Historic Economic Centres**
- Retrofitting of the historic market center through improved public transport connectivity and effective distribution management
- Proficient vending and increased retail footstep through effective space management
- Desegregating the proposed metro station to market through an overhead pedestrian bridge
- **Innovation Of Downstream Clean Up Of Drainage System**
- Green drives for water body clean up
- Improved groundwater recharge
- Creating a lively and accessible public space within the ABD
- **Preservation And Redevelopment Of Centrally Located Parkland**
- Revitalizing the central city through pedestrian connectivity and placemaking
- Desegregate the green network for heritage and cultural places around Kabban Park
- **Increasing Affordable Housing Stock Through Slum Development**
- Upgrading of housing units
- Physical infrastructure – sanitation, street lighting, roads, and water supply
- Social infrastructure – Community Center
- **Health Care Facility Retrofitting**
- Health care center construction redesigned
- Heritage protection of building

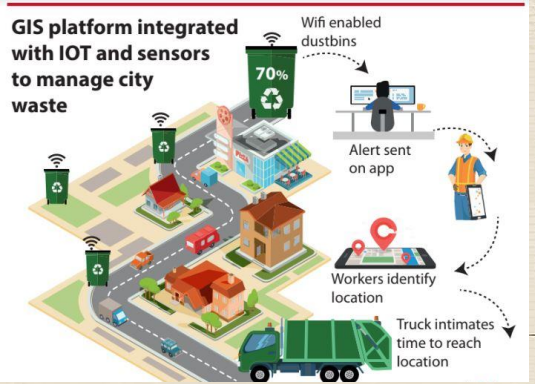
Seoul Capital of South Korea

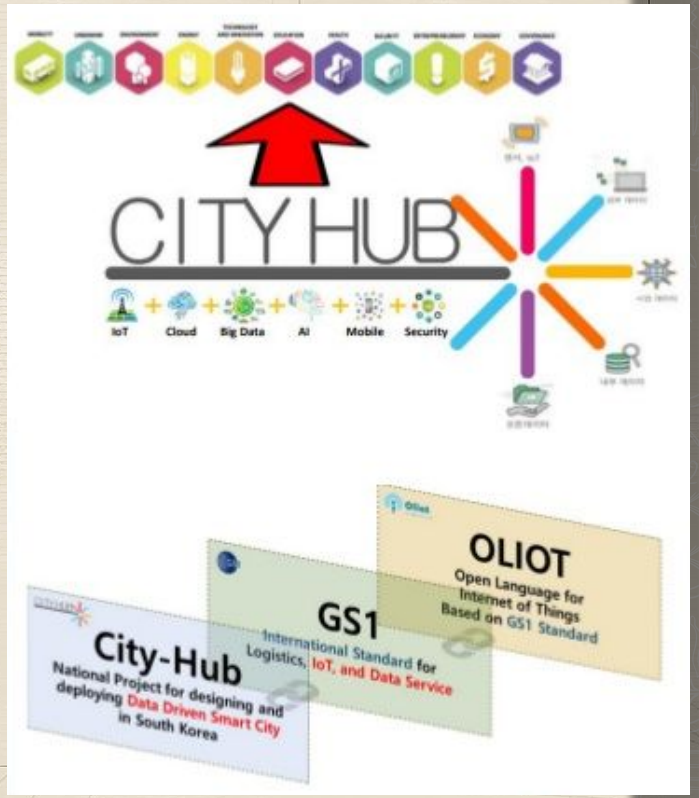
Clean up the city,

Recycling bins were linked to computer network , that received live updates on the bin's fill level

More efficient collection routines Within 3 months cost cut by 83 %




GIS platform integrated with IOT and sensors to manage city waste
Wifi enabled dustbins
70%
Alert sent on app
Workers identify location
Truck intimates time to reach location



Songodo city in south Korea

The Korean government has devised a growth strategy Economic by making Korea the business hub Northeast Asia and its transformation into an economy Knowledge-based and service delivery.

This strategy involves creating three Growth poles of reclaimed land, Help create proximity to an airport Incheon

These poles are: Songodo, Cheongra, and Yeongong, and they constitute three free economic zones

It occupies the first place in the global ranking of smart cities as the largest city
It was developed using LEED Leader in Energy and Environmental Design In energy and environmental design.

Arrival Estimation Service

Traceability Service

Recall Service

Nearby School Service

Advertise-ment Service

Korea, Busan Bus

Spain, Santander Bus

Manufacturing Data

(Parts, Factory, Manufacturing date)

Registration/ Inspection Data

(VIN, Plate Number, Reg. Number, Owner, Inspection Data)

Sensor Data

(Location, Speed, RPM)

Accident Record Data

(Date, Location, Damages)

Barcelona

reducing **traffic with s. Parking system**,

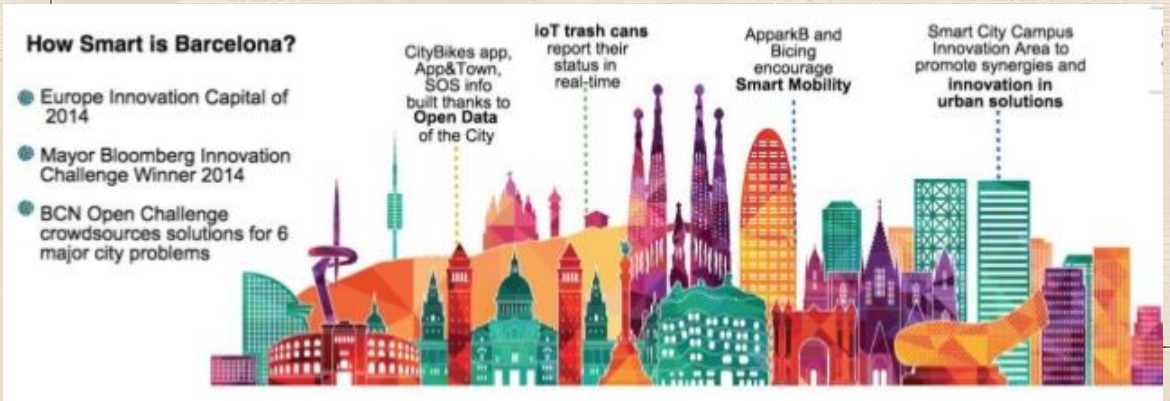
40 % of traffic is caused by drivers looking for parking spaces.

by installing sensors across the city- use s.phone APP . Live feed

reduced waste time increased better traffic flow . Save environment and petrol , data parking pattern .

Create an ecosystem that industry and academia cooperate under the shared value

• Open various city public data ➔ Drive development of creative smart city services • Operate data-driven City OS platform • Based on IoT platforms

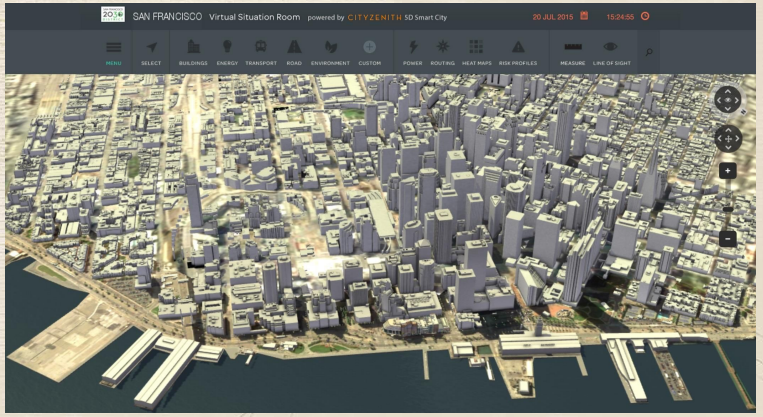

How Smart is Barcelona?
Europe Innovation Capital of 2014
Mayor Bloomberg Innovation Challenge Winner 2014
BCN Open Challenge crowdsources solutions for 6 major city problems
CityBikes app, App&Town, SOS info built thanks to Open Data of the City
IoT trash cans report their status in real-time
ApparkB and Bicing encourage Smart Mobility
Smart City Campus Innovation Area to promote synergies and innovation in urban solutions

Virtual Singapore

Berlin’s 3D City Models

Manchester

San Francisco virtual situation



London

SCOOT **traffic system**,

online computer monitors live traffic flows from **15,000 detectors**

and optimizes signal timings across traffic lights,
has **reduced delays** in the UK capital

Metro
Collect energy while using breaking
Within week – generate energy enough for 2 days operating using one reflector only .

https://maps.london.gov.uk/lbsm-map/public.html?fbclid=IwAR0FXy2FzfUKDkSE_q-BVbDgTYFzy6SJJK-iv-yuPCosnSy65tXAC4CHl4s
http://www.imactivate.com/

https://westyorks-ca.maps.arcgis.com/apps/webappviewer/index.html?id=a186b1f088734f58acafc67e71ba306e

https://odileeds.github.io/traffic-growth/
https://epc.opendatacommunities.org/domestic/search

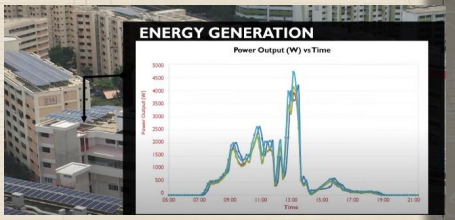
Singapore

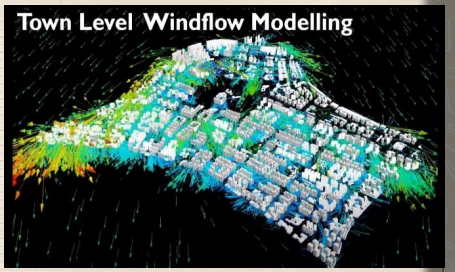
ranked **top** in **mobility, health, safety and productivity**

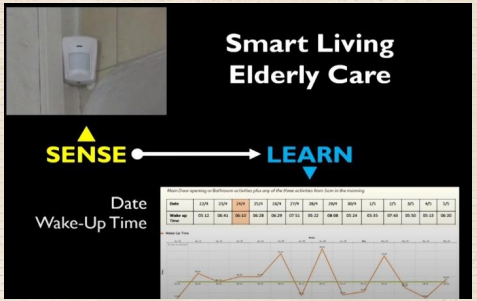
smart technology to improve the **flow of traffic** reduce the number of vehicles on its roads.

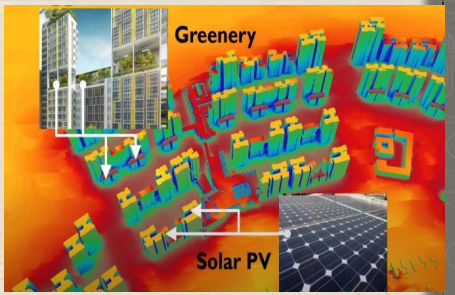
smart video surveillance to detect **criminal activity**

and used **digital service platforms and remote monitoring devices** to increase, and improve, access to **healthcare**, particularly among its **older citizens**.





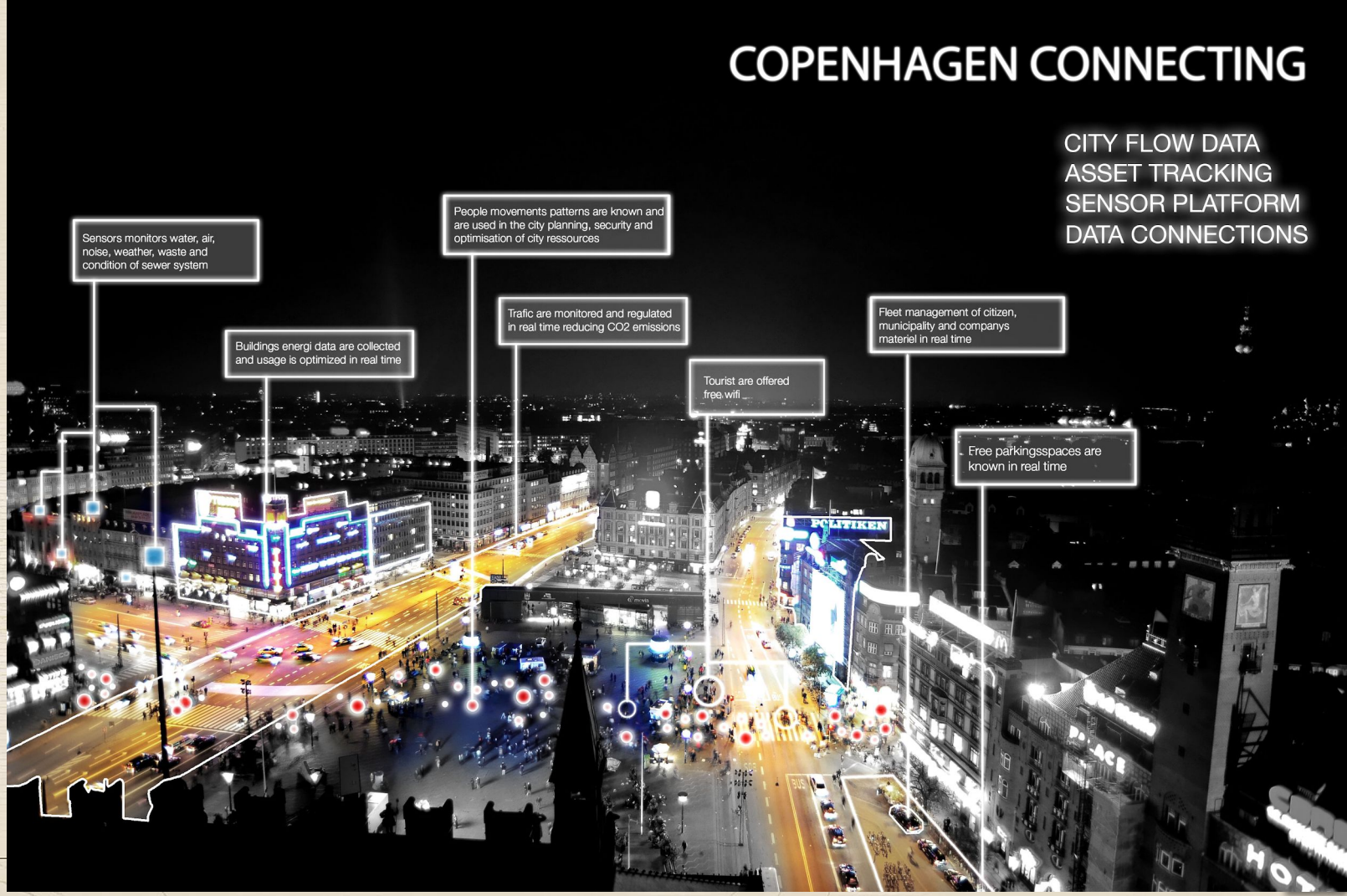




Source - How we design and build a smart city and nation | Cheong Koon Hean | TEDxSingapore

https://www.sgbike.com.sg/

Copenhagen


COPENHAGEN CONNECTING
CITY FLOW DATA
ASSET TRACKING
SENSOR PLATFORM
DATA CONNECTIONS
Sensors monitors water, air, noise, weather, waste and condition of sewer system
Buildings energi data are collected and usage is optimized in real time
People movements patterns are known and are used in the city planning, security and optimisation of city ressources
Trafic are monitored and regulated in real time reducing CO2 emissions
Tourist are offered free wifi ...
Fleet management of citizen, municipality and companys materiel in real time
Free parkingsspaces are known in real time
POLITIKEN

Cyberjaya city in Malaysa

The city is 40 km from
The Malaysian capital, Kuala Lumpur, reaches
Its area is about 7000 acres.
It is considered the first smart city in Malaysia . Opening it to be a corporate center International Information Technology

The stages of establishing the city

In the first year: attention was directed to
Facilities and infrastructure design As basic as postal service and methods Access and communications infrastructure.

- In the second year: raising the efficiency of the structure
IT infrastructure Communications and commercial facilities.
- In the third year: the high quality of the structure IT infrastructure and facilities
And communications.

City goals

Make the city an investment center, my favorite
For technology companies with a reaffirmation
On its current location as the prime location
For information and communication technology.

Promote an attractive investment ecosystem
Targeted.

Encouraging the private sector more
Investment incentives to create
Their companies in this city are exploiting
Information and communication technology.

Create high-tech job opportunities
For Malaysians.

SMART APPLICATIONS IN THE CITY

- **E-government:** It is the main application and includes the Federal Administration Center in Putrajaya is the main factor in e-government development. It will be used Information and communication technology to allow citizens and businesses to communicate with Government agencies efficiently, and vice versa.

- **World's first multipurpose card**: This project created a smart card "MyKay", to replace your old ID card. It is used like a credit card. ATM bank card, driver's license, health ID card, and card Security identity.

- **Smart schools:** where smart schools are provided with internet facilities and technology Information and communication to allow students to participate in virtual classes And gain knowledge of using technological facilities.

- **Research and Development Group:** includes the development of information technology research and development And communications by encouraging institutions, companies and academic institutes To collaborate in research. Hence, this effort could cultivate generations of Young people in creative information and communication technologies.

SMART APPLICATIONS IN THE CITY

- **Telehealth:** This project provides healthcare services from: Through telematics and telecommunications. Multimedia Corporation Super Corridor also aspires to be the regional healthcare hub for Distance or telemedicine.

- **E-business:** is to encourage local and international companies that have been established Internet or multimedia business

- **Technology Entrepreneurship Development:** This is a new enterprise expansion project Information and communication technology in the world (small and medium) in Malaysia.

- The city is considered the most expensive city to be built from The private sector worth more than 35 billion Besides, dollars are a landmark Cisco smart.
- Designed and supervised by a partnership between Cisco Technology Advanced International Agent and Morgan Stanley.
- It has adopted high-tech sensors in all buildings And streets to assess and adjust the amount of energy consumption
- The city has wireless communication networks that link all information systems either Whether it is residential, commercial, medical, or government, on the World Wide Web.
- Cisco has prepared connections between every inch in the city and installed

*"Future technologies form the cornerstone for **NEOM**'s development:*

*disruptive solutions for **transportation***
from automated driving to passenger drones,

*new ways of growing and processing food, **healthcare** centered around the patient for their holistic well-being,*

*wireless high speed internet as a free good called '**digital air**', free world-class **continuous online education**,*

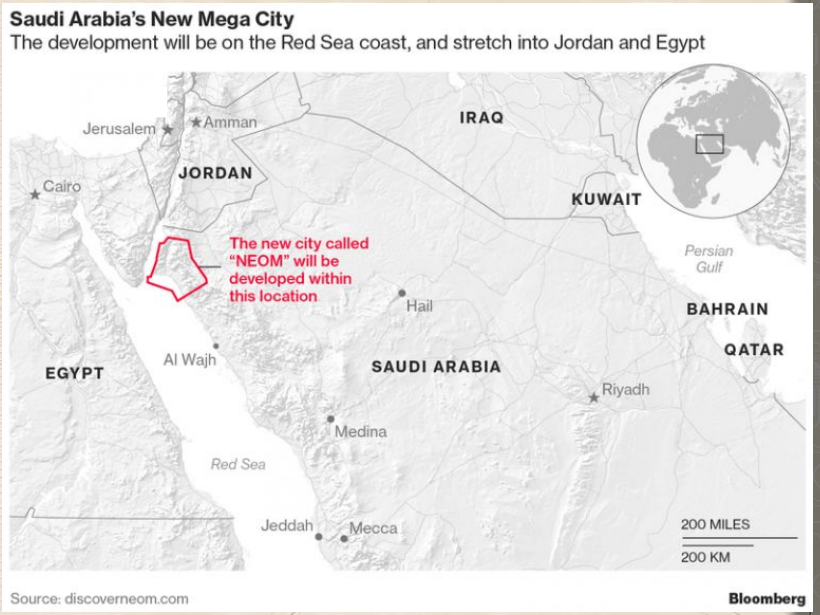
***full scale e-governance** putting city services at your fingertips,*

***building codes** that make **net-zero carbon houses** the standard,*

*a city layout that **encourages walking and bicycling** and all solely powered by **renewable energy** just to name a few.*

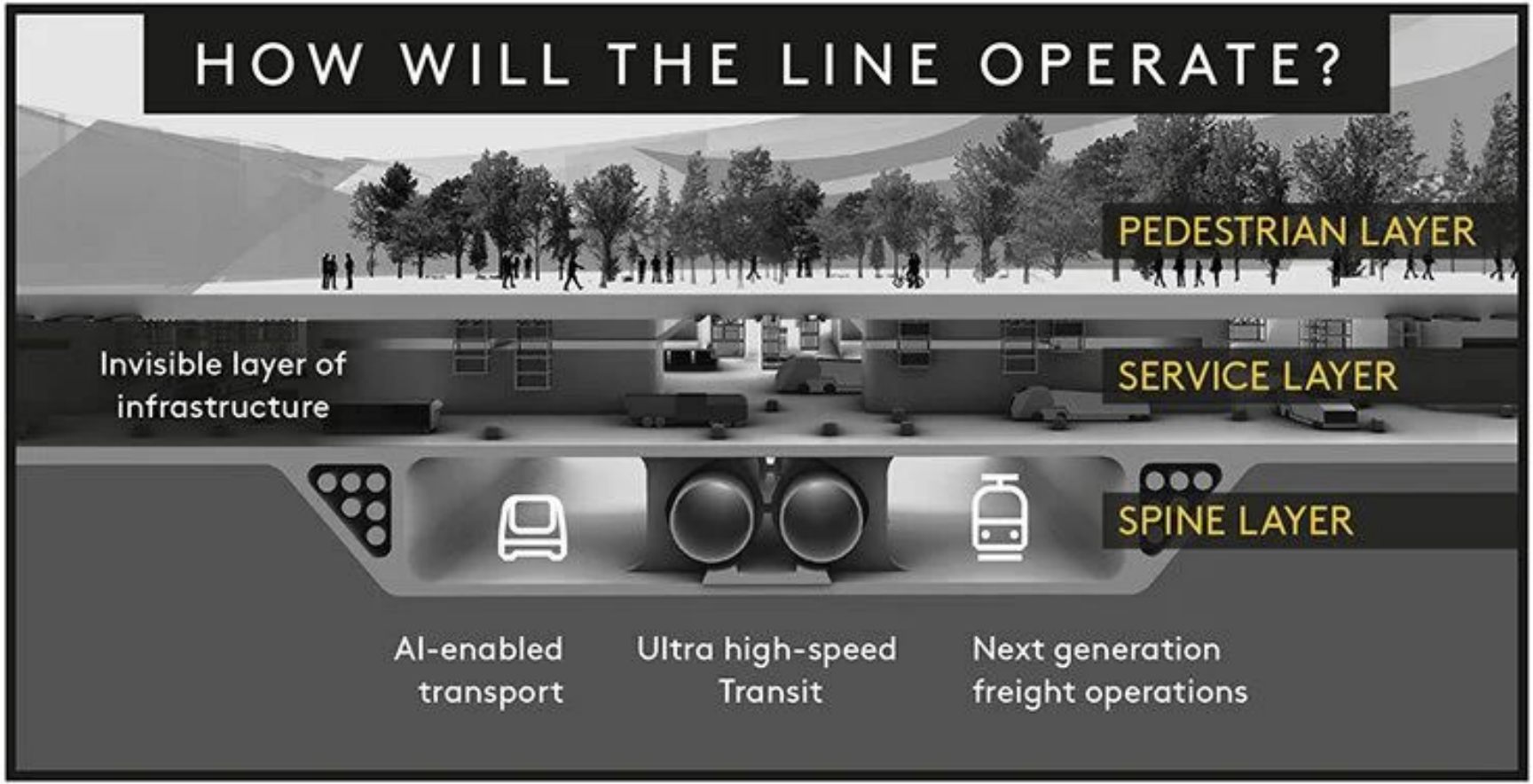
*All of this will allow for a new way of life to emerge that takes into account the ambitions and outlooks of **humankind paired** with best future technologies and outstanding economic prospects."*

"We will build the city from scratch," said **Crown Prince Mohammed bin Salman**. *"It will be **drone-friendly** and a center for the development of **robotics**. We want to create something different. NEOM is a place for dreamers who want to create **something new** in the world, something extraordinary*



SAUDI ARABIA UNVEILS THE LINE, A LINEAR DEVELOPMENT OF SMART CITIES CONNECTED WITHOUT CARS

WHAT IS THE LINE?
A REVOLUTION IN URBAN LIVING
COMMUNITIES WILL BE FORMED ALONG THE LINE
100%
renewable energy system
170km
long city of one million residents
20mins
will be the longest journey time end to end
95%
of nature in NEOM land is protected


HOW WILL THE LINE OPERATE?
PEDESTRIAN LAYER
Invisible layer of infrastructure
SERVICE LAYER
SPINE LAYER
AI-enabled transport
Ultra high-speed Transit
Next generation freight operations

CONGESTION

THE LINE

0%

CONGESTION

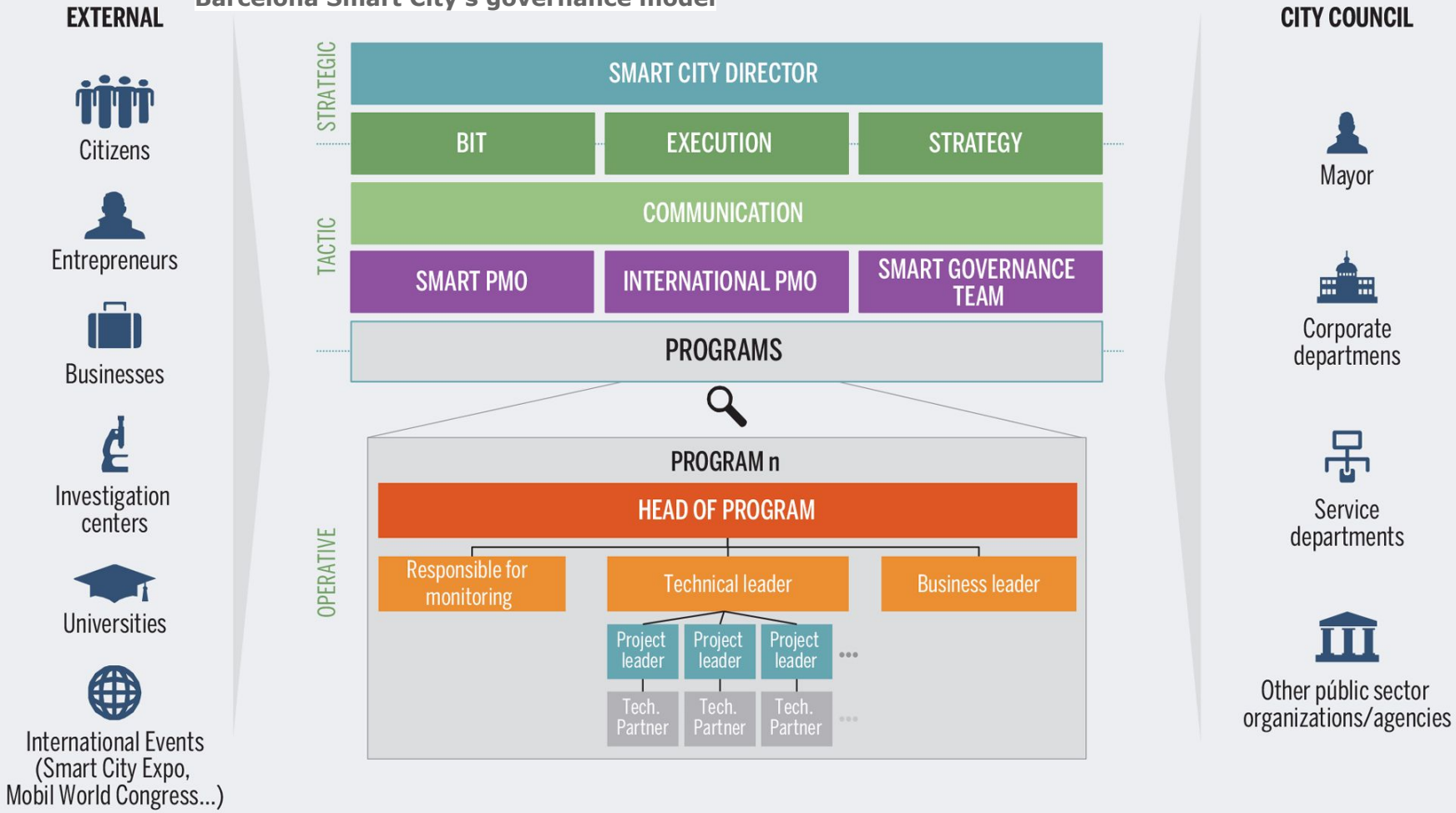
THE LINE – zero cars, zero streets.

OVER THE PAST DECADE, CONGESTION IN MAJOR CITIES HAS INCREASED

PARIS	BEIJING	LONDON	NEW YORK	LOS ANGELES
9%	9%	14%	30%	36%

Drivers in the top 10 most congested cities lose on average 168 hours per year due to congestion

Barcelona Smart City's governance model



Qatar's SMART CITY

Build digitally first.

Smart Transportation

"Smart city means a city that has all the services we need and provide an environment that fosters a happy and safe life,

https://www.motc.gov.qa/ar/qptp

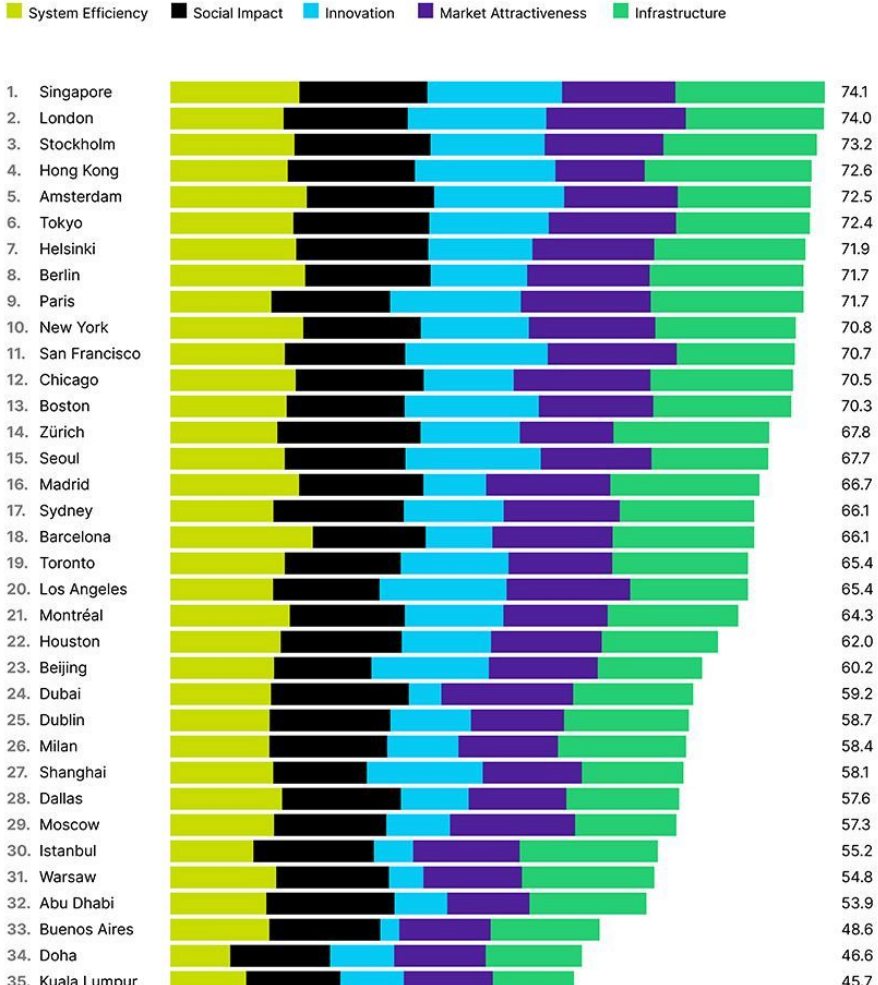
https://drive.google.com/file/d/0B1hNvn6qdcphUDctaWNLNEt0cm8/view

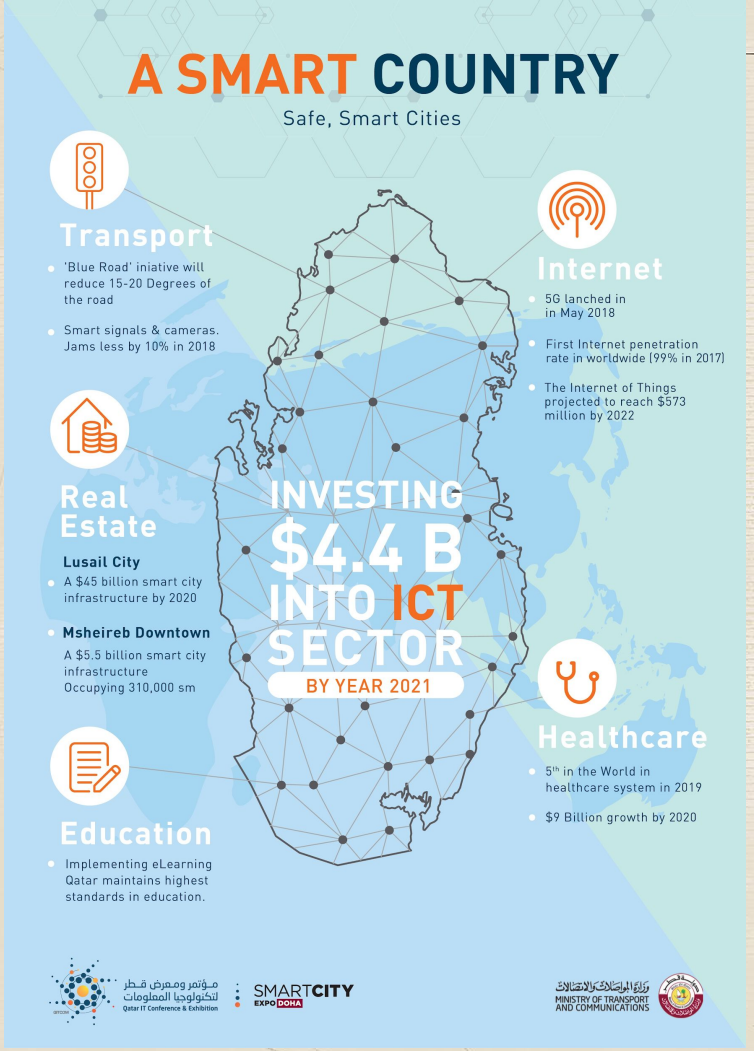
http://www.smart.gov.qa/ar/usecase/T1

Urban Mobility Readiness Index

Overall Rankings of Cities

Cities are ranked on a scale of 1 to 100, based on how well they meet five core criteria




A SMART COUNTRY
Safe, Smart Cities
Transport
'Blue Road' iniative will reduce 15-20 Degrees of the road
Smart signals & cameras. Jams less by 10% in 2018
Internet
5G lanched in in May 2018
First Internet penetration rate in worldwide (99% in 2017)
The Internet of Things projected to reach $573 million by 2022
Real Estate
Lusail City
A $45 billion smart city infrastructure by 2020
Msheireb Downtown
A $5.5 billion smart city infrastructure Occupying 310,000 sm
INVESTING $4.4 B INTO ICT SECTOR BY YEAR 2021
Education
Implementing eLearning Qatar maintains highest standards in education.
Healthcare
5th in the World in healthcare system in 2019
$9 Billion growth by 2020
مؤتمر ومعرض قطر لتكنولوجيا المعلومات
Qatar IT Conference & Exhibition
SMARTCITY EXPO DOHA
وزارة المواصلات والاتصالات
MINISTRY OF TRANSPORT AND COMMUNICATIONS

https://www.data.gov.qa/explore/?sort=title

العناية الرقمية المتكاملة
Integrated Digital Care
Parents can log into Patient Portal to view
the child's clinical record and future appointments
MyHealth
Home
MoPH
60
95
15
37.0

TASMU Smart Qatar focuses on 5 priority sectors

تسمو
TASMU

Logistics

Healthcare

Environment

Transportation

Sports

https://www.tasmu.gov.qa/en

https://tdv.motc.gov.qa/ar

https://hukoomi.gov.qa/ar/resident-employee

Smart Airport Programme

KAHRAMAA
كهرماء
المؤسسة العامة القطرية للكهرباء والماء
Qatar General Electricity & Water Corporation

مشروع تطوير البنية التحتية للعدادات الذكية

يتمثل المشروع في توفير برمجيات متطورة تمثل البنية التحتية لنشر عدادات الكهرباء والماء الذكية كأحد مكونات الشبكة الذكية بما يدعم تحقيق أهداف قطر المتعلقة بالمدن الذكية.

سيمنز الألمانية

الشركة المنفذة

30 مليون ر.ق.

التكلفة الإجمالية للمشروع

9 أشهر

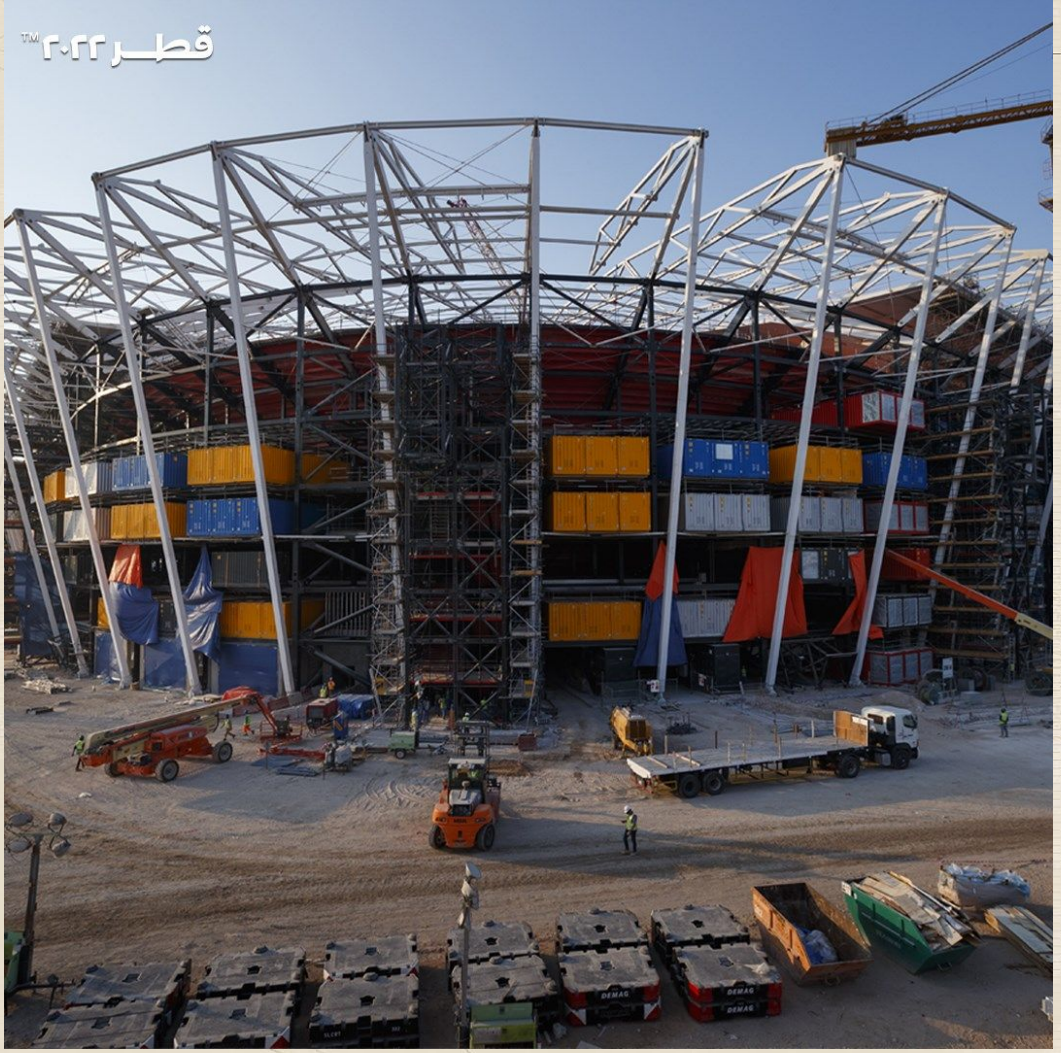
فترة تنفيذ المشروع

نهاية 2020

المرحلة الأولي لتركيب العدادت الذكية

60000 عداد ذكي

خلال المرحلة الأولى


قطر ٢٠٢٢™

Smart City Examples

- Songdo: http://songdoibd.com/about/
- Vienna: https://smartcity.wien.gv.at/site/en/
- Berlin: http://www.berlinpartner.de/fileadmin/user_upload/01_chefredaktion/02_pdf/ 02_navi/21/Strategie_Smart_City_Berlin_en.pdf
- Helsinki: http://fiksukalasatama.fi/en/

Five Challenges in Building Smart Cities

Infrastrcuture

Multiple Service Providers

Resources

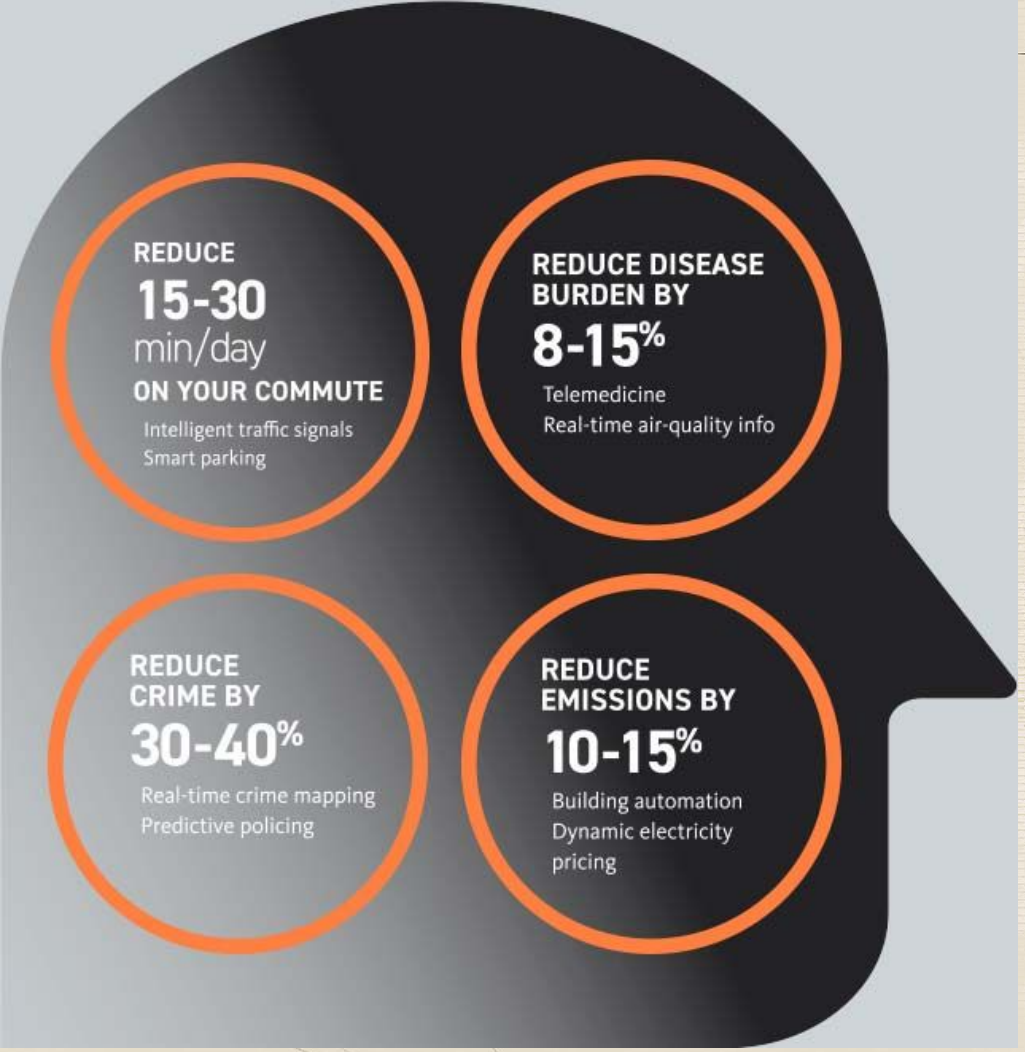
Perception

People

Conclusion

We actually don’t need Smart Cities……

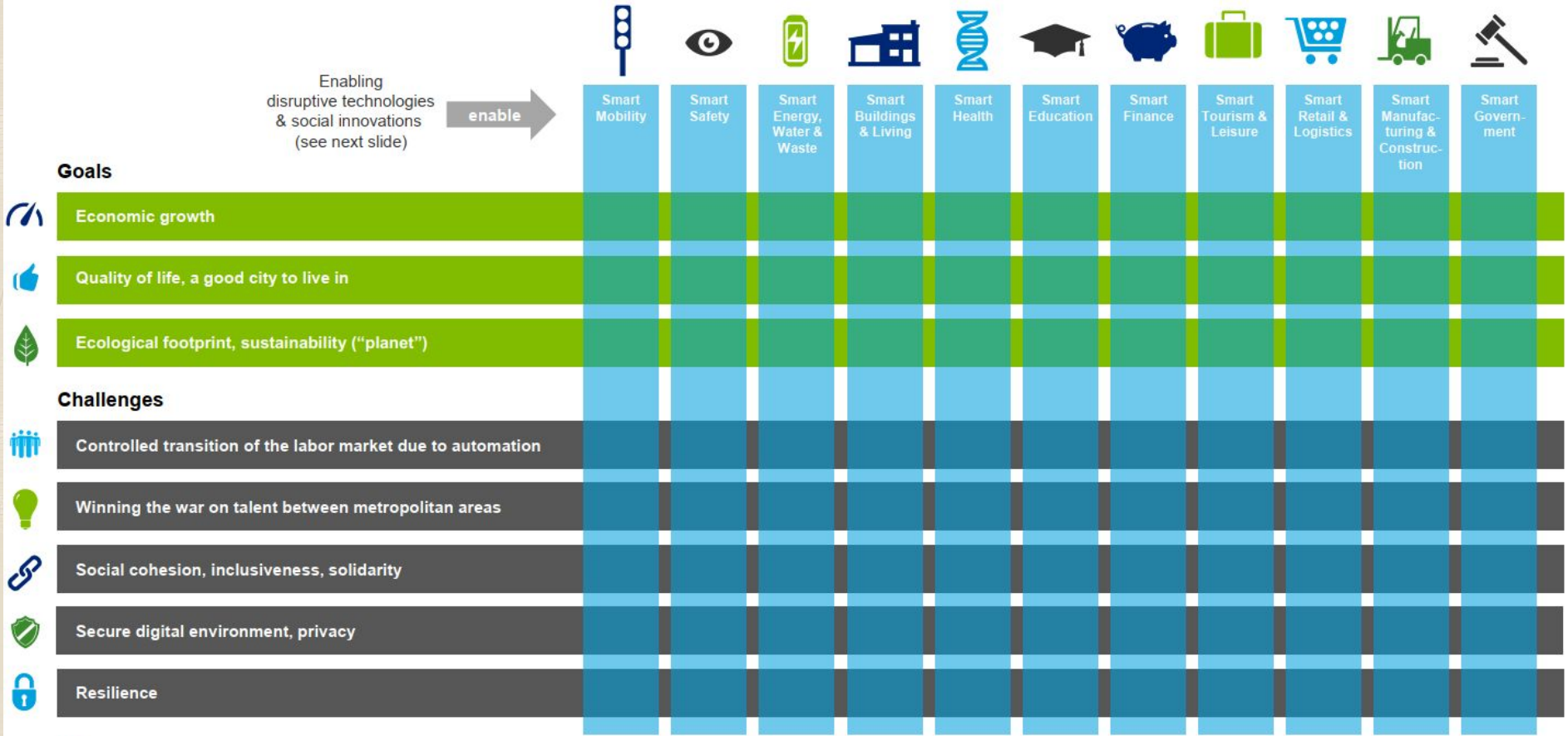
We need to create….. Smart Citizens!


REDUCE
15-30
min/day
ON YOUR COMMUTE
Intelligent traffic signals
Smart parking
REDUCE DISEASE BURDEN BY
8-15%
Telemedicine
Real-time air-quality info
REDUCE CRIME BY
30-40%
Real-time crime mapping
Predictive policing
REDUCE EMISSIONS BY
10-15%
Building automation
Dynamic electricity pricing

Smart City Standards

- The development of a standard on Smart city terminology (PAS 180)
- The development of a Smart city framework standard (PAS 181)
- The development of a Data concept model for smart cities (PAS 182)
- A Smart city overview document (PD 8100)
- A Smart city planning guidelines document (PD 8101)
- Mapping research and modelling for Smart Cities
- Guidance on the Economic Assessment and Funding of Smart City Initiatives

Smart cities emerge as the result of many smart solutions across all sectors of society



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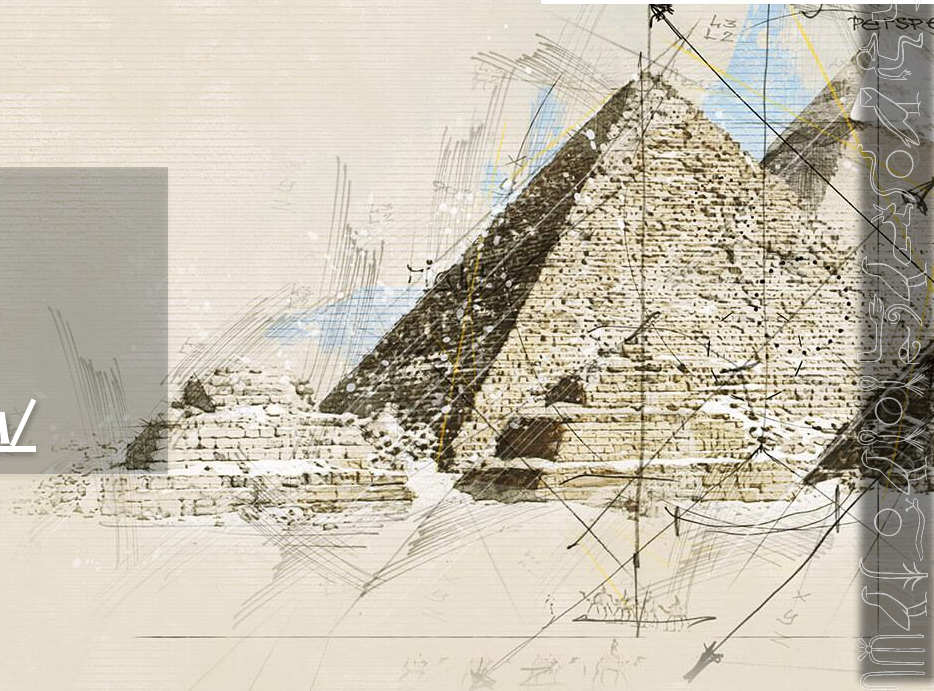
Thank You for attending this presentation

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